



MAP COURTESY OF THE UNIVERSITY OF WASHINGTON SPECIAL COLLECTION

Exhibit 3-1: City of Seattle in 1891

## CHAPTER 3 - THE PROJECT AREA THEN AND NOW

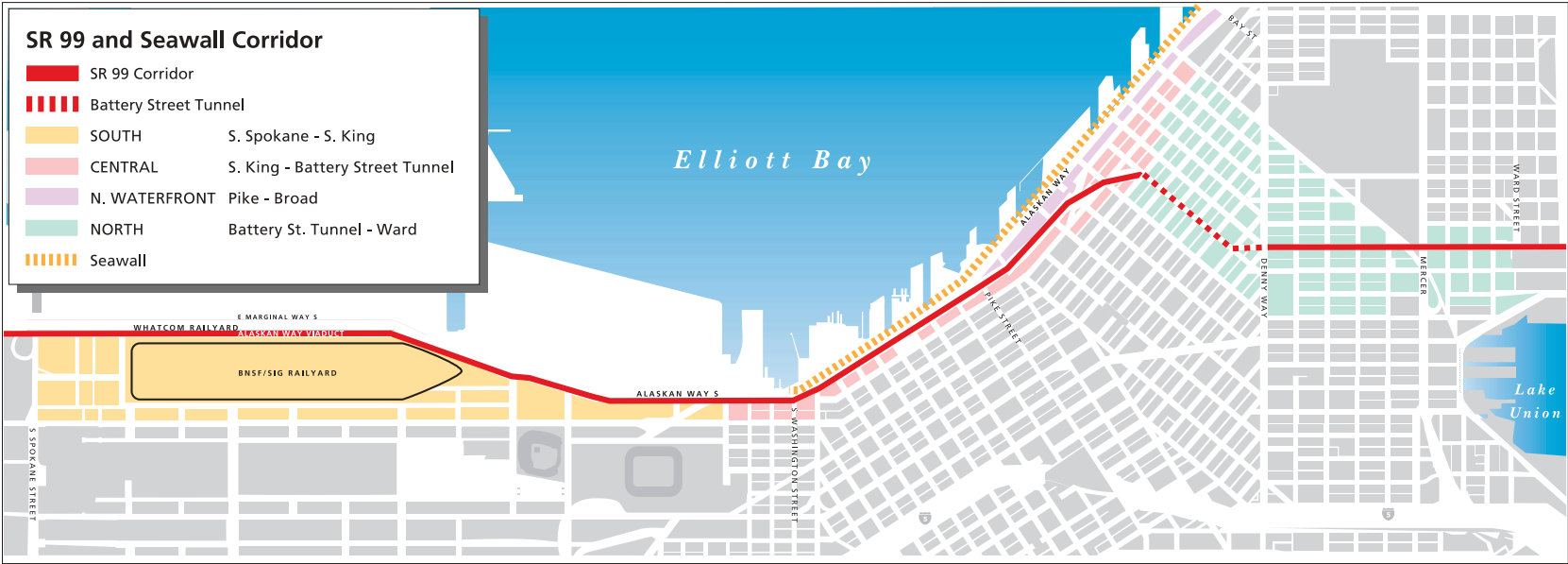
### 1 What are the project boundaries and why were they selected?

The Alaskan Way Viaduct and Seawall are located in downtown Seattle, Washington. The project corridor is 4 miles long, extending from approximately S. Spokane Street in the south to Ward Street north of the Battery Street Tunnel. The Alaskan Way Seawall is within these boundaries, extending from S. Washington Street to Bay Street at the edge of Elliott Bay on Puget Sound.

The project boundaries are based on the areas needed to replace the viaduct and seawall and to construct the project. The project boundaries include proposed detour routes and construction staging areas.

Because the project area is large, it has been divided into four sections for discussion in this Draft EIS as shown in Exhibit 3-2:

- South - S. Spokane Street to S. King Street.
- Central - S. King Street to the Battery Street Tunnel. The central section follows the viaduct structure curving up to the Battery Street Tunnel.
- North Waterfront - Pike Street to Broad Street. The north waterfront section includes the Alaskan Way surface street and seawall from the point where the viaduct begins to veer off to the Battery Street Tunnel around Pike Street to Broad Street.
- North - Battery Street Tunnel to Ward Street. The north boundary extends to Ward Street because some changes in the street grid could occur to maintain or improve the traffic flow during the construction and operation of an alternative.



### 2 What elements of Seattle's history have shaped the project area?

The decision about the viaduct and seawall's replacement will be influenced not only by the transportation needs and other uses in the project area, but also by the land beneath the viaduct-the actual foundation of future improvements. To understand the problem, it helps to take a step back and look at the forces that have shaped the land around and under the viaduct. Some of these forces are part of the human history of the project area, like the efforts of turn-of-the-century Seattleites to level hills that stood in their way and extend the narrow shoreline where early Seattle took



Exhibit 3-2



root. Equally important are the natural forces and physical geography of the land in the project area, which continue to affect it today.

Earth Movements

One of the major forces affecting the Seattle waterfront lies far beneath the coastal waters of Washington State. There, an upwelling of molten rock from deep within the earth is forcing apart the solid rock of the earth's crust along a long line that follows the coasts of Washington and Oregon. Over many millions of years, this slow but powerful force has fractured the ocean floor to a depth of several miles, splitting off a vast piece of the earth's crust (named the Juan de Fuca Plate) and pushing it eastward on a slow-motion collision course with the coast of Washington.

At the point of collision, the Juan de Fuca Plate is pushed beneath the plate of land that makes up the west coast of the North American continent. The entire front edge of the North American Plate is uplifted (something like the prow of a boat being pushed up by a wave), while inland it is tilted downward. The uplifted edge is the Olympic Mountains, while the down-turned area is a trough between the Olympic Mountains and the Cascade Mountains. As the Juan de Fuca Plate slides beneath the North American Plate, friction between them causes both of them to compress, rotate, and fracture into pieces (sometimes miles across) in a broad area that includes the Seattle waterfront. The Seattle Fault Zone is the name for the boundaries between several of these fractured pieces, located at the southern end of the project area.

The movement of a great landmass can be gradual and imperceptible, but occasionally it can be sudden and abrupt, causing the entire landmass to shudder violently. This movement is what we experience as earthquakes. The strongest recorded earthquakes in the project area have originated in the Juan de Fuca Plate, after it has been forced far below the overlying North American Plate (to depths of 32 miles and greater). Earthquakes that occurred at these depths include the 1949 Olympia earthquake, the 1965

Seattle-Tacoma earthquake, and most recently, the 2001 Nisqually earthquake.

Two other types of earthquakes affect the project area. Shallow crustal zone earthquakes occur 12 miles or less beneath the Earth's surface, when fractured pieces of the earth's crust move suddenly in an up/down direction (this is what happens in the Seattle Fault Zone). Interplate earthquakes-potentially the strongest quakes that could affect our area-occur at the interface between the Juan de Fuca and North American Plates. Although no interplate earthquakes have occurred in the project area in recorded history, geologists believe that in the past, this type of quake has caused estuaries in our region to rapidly subside, lowering the elevation of coastal areas by several feet.

When the Alaskan Way Viaduct and Seawall were built, little was known about the nature of earthquakes in this region, or how to design structures to withstand them. A key part of the Alaskan Way Viaduct and Seawall Replacement Project will be replacing the old viaduct and seawall with structures that are safe, even when the earth moves beneath them.

Rivers of Ice

To find the origin of most of the soil types in and around the viaduct, one needs to look back in geologic history, to the time when our region was shaped by the Ice Ages. Geologists have developed maps that show the types of soil found in the project area. The maps show a complicated variety of irregular shapes representing sand, silt, gravel, clay, peat, boulders, and various combinations of these things. Some of this variety is due to Seattleites digging, moving, and importing soil for a century and a half.

Beginning about two million years ago, the earth's climate went through at least six periods of cooling that caused glaciers to cover the Puget Sound region with vast sheets of ice flowing slowly in a generally southward direction. The ice was very thick; the last glacier to cover the project area 13,500 years ago is estimated to have been 3,000 feet from top to bottom. The massive ice flows bulldozed the land beneath them, gouging valleys, deepening Puget Sound, and push-

Cascadia Subduction Zone and the Juan de Fuca Plate



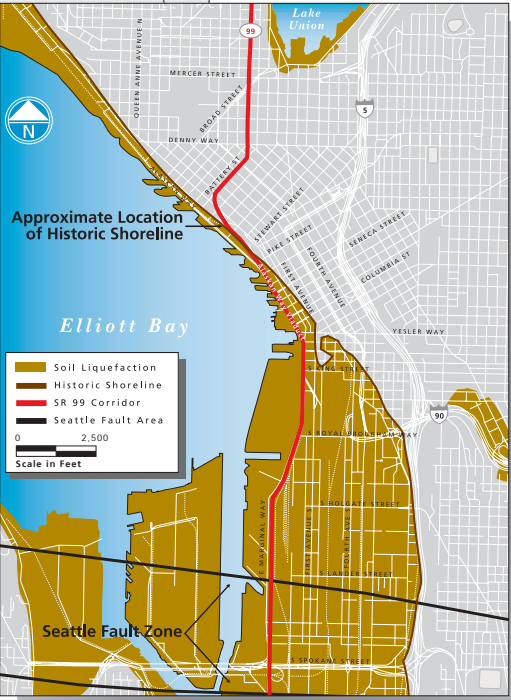
Exhibit 3-3

ing up huge piles of gravel and soil that became the hills that we know in present day Seattle. The steep slopes in the corridor are a good example of landforms created by the force of these ancient ice flows. As the glaciers melted and retreated from the area in and around the corridor, they left behind enormous quantities of assorted material that had been displaced by the scouring force of glacial movement. Although in a few spots in Seattle one can see bedrock right at the surface, in the project area, gla-

What is Liquefaction?

Liquefaction is what can happen to loose soils when shaking motion from an earthquake causes the soil to turn into a quicksand-like condition. This can cause foundations to fail.

Exhibit 3-4



Soil Liquefaction and the Seattle Fault

ciers dumped layers of material covering the bedrock to a depth of up to 2,700 feet. Most of this material was tightly compacted by the weight of the glaciers, while some of it was randomly deposited at the foot of retreating ice sheets.

Over the years, rock and soil were gradually weathered and altered by water, wind, and temperature. Creeks were fed by water percolating into the glacial soils. The shoreline in the project area was eroded by the forces of tides and waves. Occasionally the landscape would change dramatically-entire sections of hillside would break off and slide, creating bluffs like the one that can still be seen along the waterfront at Pike Street. After time, the waters at the edge of Elliott Bay grew shallow and muddy, as soils were carried downhill from as far away as Mt. Rainier and deposited near the shoreline, and the discharge of the Duwamish River released its load of sediment. Periodically, eruptions from Mt. Rainier also instigated soil movement and deposition in tributaries that fed the Duwamish River. Finally, plants recolonized the glacier-scoured landscape, adding organic material to the barren soil and providing habitat for humans and for terrestrial and aquatic wildlife.

Understanding the geological character of the project area is an important part of planning and designing the replacement of the viaduct and seawall. For instance, highly compacted glacial material will be a sturdy base for the viaduct and seawall. However, we may need to dig down through as much as 250 feet of loose fill and sediment to get to that base. Some soils in the project area were naturally washed down from the surrounding hillsides, or carried by river from the Cascade Mountains. Some of the soil is fill placed there much more recently, by humans. Much of the project area's amazing geological story was played out thousands of years ago. But to really understand the whole story, you need to know how and why the land was changed to suit the ambitions of people who lived here before us.

**Stories Without Words - Archaeological Resources**

More than 5,000 years before eighteenth-century European explorers first sailed Washington's inland



waters, native peoples made their way to the shoreline of what is now downtown Seattle. Some of these peoples passed through, gathering for a while to take advantage of seasonal abundances, while others settled permanent communities. The story of native peoples who lived in the project corridor is told largely by the remains of objects they left behind, such as matting, basketry, fish weirs, stone hearths, tools made of bone or stone, and shells and stones used in shellfish processing. Because only the most recent part of their history has been recorded, archaeologists believe that some of these objects may exist at a number of places within the project corridor, including beaches and tideflats that have been filled, landslide deposits, former bluff tops, and the site of a ravine-filled during



the regrading of Seattle's hills-where part of Belltown is now located.

More recent peoples, both native and European, also left behind physical evidence. Former tidelands and beaches that were filled between 1860 and the early 1900s may contain remnants of piers, wharves, roadbeds, discarded remains of household items, industrial refuse, and ballast that was dumped from visiting ships before taking on cargo. Former shorelines, areas on or below former bluffs, and areas near the bases of filled ravines may include objects deposited by native peoples who co-existed with the settlers who founded Seattle and the growing numbers of people that followed.



**Native Peoples**

**What tribes are part of Seattle's history and are they involved with the project?**

There are seven tribes and the lead agencies are consulting with for this project. They include the Duwamish, Kikiallus, Muckelshoot, Snoqualmie, Suquamish, Tulalip, and the Yakama Nation.

Throughout the project, the lead agencies have involved the tribes by sending them information, contacting them to discuss the project by phone, and requesting their input on tribal issues related to the project. In addition, one-on-one meetings have been held with some tribes at their request.

The lead agencies will continue to meet with tribal staff and members to consult with them and learn about their histories and current activities within the project study area. The agencies will continue to communicate with the tribes about concerns they might have related to project activities that may affect their heritage.

For more information about discussion with tribes, please see Appendix M.

Top Left: *Seattle Waterfront 1880s*

Top Right: *Seattle Mudflats 1889*

Below Right and Left: *Views of the Denny Regrade in progress*

PHOTOS COURTESY OF THE UNIVERSITY OF WASHINGTON SPECIAL COLLECTION

RIGHT HAND PHOTO OF THE DENNY REGRADE COURTESY OF THE SEATTLE MUNICIPAL ARCHIVES



Leveling the Hills

When the first settlers came to the shores of Elliott Bay, they saw a landscape that was very different from the one we see today. In much of what is now the project area, bluffs and heavily forested hillsides plunged directly into the waters below, with only a few narrow beaches to step on. Deep ravines along the shore made even a short overland trip difficult, and getting from one place to another might mean a rough trip by dugout canoe or rowboat followed by an exhausting scramble to the top of a bluff one hundred or more feet high.

Because the steep hills were difficult to build on, citizens of the growing community had to find inventive ways to make space for homes, businesses, and roads. Much of early Seattle, including wharves, mills, coal bunkers, streets and railroads, was built out over the tidal mudflats on a jumble of wooden pilings. Much more ambitious was the effort to move soil from slopes too steep for development, and to use it to fill shallow areas along the shoreline.

Over eight decades from the 1870s to the 1930s, entire hilltops were leveled, at first by sluicing soil into tidal areas after removing it with giant jets of pressurized water, and later on by using heavy equipment. The best known of these earth moving projects created the Denny Regrade (an area in downtown Seattle), whose name is a reminder that it was not always as flat as it is today. Other types of fill that were used to push the shoreline out into Elliott Bay included sawdust from local mills, ballast from visiting ships, assorted garbage, and soil dredged from shallow waters to make them deep enough for ships to dock. In all, over 2,000 acres of useable land were created by filling tidal wetlands and beaches, including most of the Pioneer Square area and south downtown (SODO).

One of the things that most concerns the designers of new structures along the waterfront is how all this fill soil will behave during an earthquake. Earthquakes tend to cause particles in fill soil to separate from each other, turning the soil into something very much like quicksand (geologists call the phenomenon "liquefaction"). As the soil beneath them slides and gives

way, buildings, bridges, and roads settle, tilt, move around, and even collapse (some of the damage from the 2001 Nisqually earthquake was caused this way). The problem is that the viaduct and seawall were built before we knew much about how bad earthquakes could be in the Puget Sound area. This project will give us an opportunity to replace these important structures using new quake-resistant construction methods like strengthening fill soil, shoring up structures with deep pilings, and designing all new structures so they will withstand the ground movement unleashed by an earthquake.

3 What elements of Seattle's history have shaped the development of the seawall?

The Alaskan Way Seawall was part of the project to fill the shallow waters along the downtown Seattle shoreline. Begun in 1916 and extended in 1934, the seawall holds in place the fill soil on which many of the present-day waterfront buildings, streets, and utilities are placed. In 1887, the City of Seattle established a railroad right-of-way almost entirely over the waters of Elliott Bay.<sup>1</sup> It was the only space available along the waterfront as Seattle worked to entice the Great Northern railroad to make Seattle its Puget Sound main terminus. The coming of the railroad and the continual regrading of city streets led to the inevitable filling of the area between the shoreline and railroad right-of-way. In areas without fill, railroad tracks and plank roads to the waterfront piers were built over the water on pilings. This bustling area running between the piers and the rebuilt commercial district was called Railroad Avenue. By the time of the Great Seattle Fire in 1889, the city had grown from a small logging-oriented settlement into a regionally important commercial center. The fire destroyed most of the structures in the commercial district and waterfront area, giving the community a chance to replace wooden boomtown buildings with elegant brick structures, to widen and elevate streets, and to modernize its drains and sewer systems. The old hodgepodge of waterfront piers and buildings, built without much thought for overall organization, was replaced with modern piers, sharing a standard design on an east-west alignment.

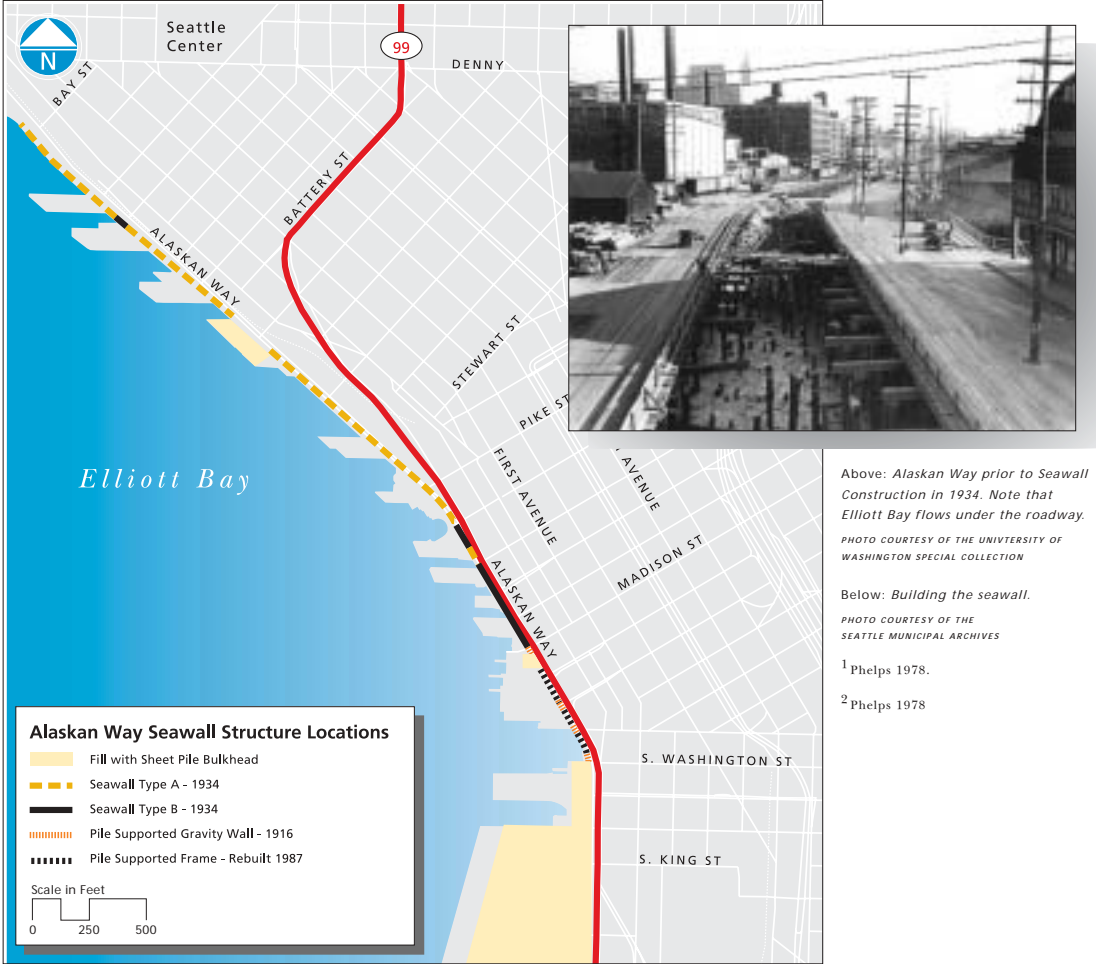


Exhibit 3-5

As Seattle grew, its port became increasingly busy. Trains traveling along clogged city streets created dangers and inconveniences for people on foot and in horse-drawn vehicles. To help solve this problem, a railroad tunnel was built in 1905 to route rail traffic away from the waterfront and under the city. But by that time, Railroad Avenue was badly in need of replacement. Pilings that were driven into soft mud were giving way, and train trestles and the roadway



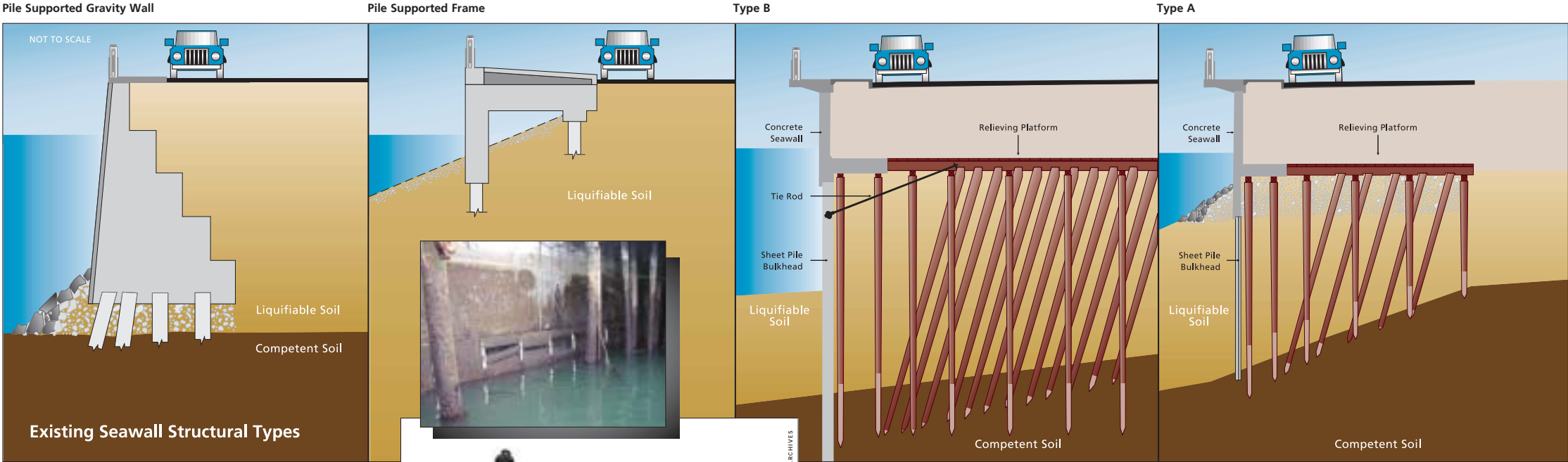


Exhibit 3-6

were sagging as the ongoing pounding of waves and passing trains continued to take their toll.

Determined to create a solution to the maintenance headaches of Railroad Avenue, the City decided to build a seawall. The seawall was desired because the fill could be covered by a roadway, improving traffic and creating a better appearance for those entering the city from the water, and the water off the seawall would be sufficiently deep to accommodate ships. <sup>2</sup>

Four types of seawall were constructed along the waterfront: Pile-Supported Gravity Wall and Frame, Type B Seawall, and Type A Seawall. Located between S. Washington Street and Madison Street, the Pile-Supported Gravity Wall and Frame was the first section of seawall built in 1916. The outside of the wall was built right up to the shoreside ends of wharves and backfilled with imported soil, replacing old structures on pilings with solid ground. The sections of Pile-Supported Frame were replaced in either 1964 or 1987; however, the replacement sections were not



Above Left: Holes in the seawall facade today.  
Center Left: The construction of the seawall.  
Lower Left: Pumping out a test pit  
Above Center: View of a seawall test pit, 2002 showing damage to the relieving platform.  
Above Right: Close-up view of relieving platform damage  
Left: Damaged seawall bolt.



designed for liquefaction. From 1934 to 1936 the Type B and Type A Seawall were built between Madison and Bay Streets (Myrtle Edwards Park). The new roadway running along the waterfront on newly filled areas (replacing Railroad Avenue) was named Alaskan Way-commemorating the hopeful prospectors who used Seattle as a starting point in their search for the riches of the Alaska Gold Rush in the 1850s.

4 What is the seawall's condition today?

Inspections of the seawall following the Nisqually earthquake have revealed that a combination of deterioration and soil movement has weakened it. Widespread damage has been caused by tiny crustaceans called gribbles. Unfortunately, the gribbles have been at work for a while and their work continues. They have managed to destroy portions of the seawall's relieving platform. The seawall is held up by the relieving platform, which extends between 40 and 60 feet east of the seawall. The relieving platform and its support piles also hold up the sections of the Alaskan Way surface street and underground utilities.

During the summer of 2002, WSDOT and the City dug six large pits along the seawall between Columbia Street and Myrtle Edwards Park to determine its condition. Damage from the gribbles was found to some degree in all of the test pits. Extensive damage to the relieving platform and its connection to the concrete face panel was found in three of the pits. The platform at the remaining three test pits was reported to be in fair to good condition.<sup>3</sup> Field studies helped provide additional information on the seawall's condition. A total of 102 probes were inserted in 51 locations along the seawall. The results showed that in 24 locations (or about half of the locations) an object was not hit, meaning that in those areas the relieving platform and connection to the seawall is completely gone, or substantial sections are missing.<sup>4</sup>

In addition to the damage caused by gribbles, there is evidence that some of the fill material behind the seawall liquefied in the Nisqually earthquake. After the earthquake, a section of the Alaskan Way surface street settled near the Aquarium. In the spring of

2003, the City of Seattle repaired the damage by injecting grout into the voids that were created. During the grouting, the voids were found to be bigger than expected. In addition, a small section of the seawall in the construction zone moved slightly to the west, raising additional concerns about its stability.

5 How has Seattle's history shaped the development of the viaduct?

Until the 1920s, the gateways of Seattle-the places where most people arrived - were its waterfront and its railway stations. By water, a visitor might arrive by one of the many steamboats (called the Mosquito Fleet by locals) that served waterfront communities throughout the Puget Sound region. Travelers arriving by train would enter Seattle through Union or King Street Stations. To get from one place to another within the city, a traveler could hop on one of many streetcars. An interurban rail system carried passengers between cities in the region.

As in other places in the country, the way that people got around was changed dramatically by the growing popularity of the automobile. By the late 1920s, cars had become a major factor in the area's transportation system, and had all but taken over by the 1930s.

In 1932, the Aurora Avenue "speedway," including the Aurora Bridge, opened to traffic. The speedway was designed to give cars and trucks a quick route from north Seattle to downtown without the distraction of intersections or traffic signals.

In 1934, planning started on a bypass route connecting Aurora Avenue to Pacific Highway, south of the city. Government officials and civic supporters agreed on the route.<sup>5</sup> Just south of Pioneer Square, a double-

PHOTO COURTESY OF THE SEATTLE MUNICIPAL ARCHIVES



Top: The beginning of viaduct construction in a 1949 photo taken near Marion Street.

Above Right: Weak column reinforced with steel rods

<sup>3</sup> Shannon and Wilson

<sup>4</sup> Shannon and Wilson

<sup>5</sup> National Register 2001

<sup>6</sup> National Register 2001

<sup>7</sup> Phelps 1978, National Register 2001



Above Right: View of Alaskan Way near Seneca Street as seen from the Viaduct today.

Above: Misaligned expansion joint.

Right: Exposed rebar



level aerial structure would rise alongside Seattle's waterfront. The roadway would continue north and would enter a new tunnel beneath Battery Street in the vicinity of First Avenue. The tunnel would surface near Denny Way and connect to Aurora Avenue.

Construction of the bypass route began in December 1949 and continued for over 8 years.<sup>6</sup> The first section of the viaduct was opened to traffic in 1953, followed by the opening of the Battery Street Tunnel in 1954. The entire project was completed in August 1958. Viaduct construction had barely finished when people began pleading for on- and off-ramps into downtown. As a result, the downtown ramps at Seneca and Columbia were constructed in 1961 and 1966.<sup>7</sup> Apart from repairs, the viaduct has not changed since the 1960s.

## 6 What is the viaduct's condition today?

Investigations by engineering, structural, and seismic consultants since the mid to late 1990s have clearly found that the viaduct is old, deteriorating, and vulnerable to earthquakes. Reinforcing steel is corroding and concrete is cracking—all signs that the viaduct is aging and approaching the end of its service life. The viaduct is increasingly vulnerable to damage from earthquakes because its foundations are built in unstable fill materials supported by the aging seawall. In addition, the viaduct was designed to meet seismic criteria from the 1950s that were much less protective than today's standards.

After the Nisqually earthquake on February 28, 2001, evidence was found that the viaduct had been weakened further. Settlement had occurred, joints and columns were damaged, and new cracks were visible. Indications of early stages of soil liquefaction were also discovered. As a result, WSDOT made over \$3.5 million of immediate repairs to some sections of the viaduct, particularly a one-block section near Washington Street. WSDOT and Seattle also imposed permanent traffic restrictions that remain in effect today. These restrictions include reducing travel speeds from 50 miles per hour to 40 miles per hour for all vehicles over 10,000 pounds (such as trucks and

## Roadway Regional Network



Exhibit 3-7

buses). Also, vehicles over 10,000 pounds are required to use only the right lane of the viaduct.

## What is Service Life?

Service Life is a period of time after which it is no longer cost-effective to repair a facility.

**Why are the viaduct and seawall important to the region and nation?**

The U.S. Coast Guard's 13th District Headquarters is located on Seattle's downtown waterfront. They have a vital role safeguarding the public and shipping traffic. Failure of the viaduct or seawall could render this facility inaccessible, severely hampering the ability of the Coast Guard to perform its duties.



Ongoing inspections every 6 months have found that the viaduct is slowly getting worse. Monitoring devices have been installed to assist in determining any further changes in the viaduct. Over the last 3 years, the viaduct has continued to settle. The number and width of cracks have increased and the concrete pavement has further eroded, causing exposed rebar to deteriorate. The structural experts estimate that in the next 10 years there is a 1 in 20 chance that a quake of sufficient magnitude could cause the viaduct's failure. No longer is it feasible or cost-effective simply to retrofit the existing viaduct.

The viaduct's foundations are also embedded in the soil held back by the seawall. If the seawall were to fail, sections of the viaduct, the Alaskan Way surface street, and adjacent structures and utilities could collapse or become unsafe.

7 **Why are the viaduct and seawall so important to Seattle, the Puget Sound region, and even the nation?**

The region has relied on the viaduct and seawall between 50 and 70 years, respectively. Both the seawall and viaduct are important assets to Seattle's and the region's infrastructure. We depend on the seawall to hold up the soil that is the foundation of our waterfront. It protects major utilities that provide power, water, sewer, natural gas, steam, and communications systems throughout the area. It supports the viaduct's foundations and the Alaskan Way surface street that together carry more than 110,000 trips each day. It supports buildings located on the waterfront and some of Pioneer Square. The seawall is much more than a concrete face along our waterfront - it defines the waterfront as we know it. Without it, we would lose a portion of the city that plays an important role in our economy and provides an area where people from near and far congregate to work, live, and play.

The viaduct plays an equally important role in the transportation network in the city and the region. For more than 50 years, the viaduct has served as part of the regional transportation system along SR 99 that extends between Tacoma and Everett. Long before I-5 became the backbone of our regional transportation

system, SR 99 was the major north-south thoroughfare connecting these communities. When I-5 was built, it became the mainstay of the region's transportation system; however, SR 99 continues to provide important connections to communities built prior to and after World War II.

As the population in the region has grown, so have our transportation needs. SR 99 is the only north-south highway in the region that is not overly congested during most of the day. Without it, congestion on I-5 would increase dramatically, which would paralyze the transportation network in, through, and around Seattle. SR 99 provides a critical link and relief valve to I-5 and the region's transportation network. The ability to expand the regional network is constrained by the land and water that make the area so unique. Even though it may be hard for all of us to comprehend what it will be like to endure 7 to 11 years of construction, it is even more difficult to imagine Seattle without its viaduct and seawall.

8 **How much traffic travels on the viaduct daily?**

About 103,000 vehicles travel on the viaduct each day. An additional 9,000 vehicles travel on the Alaskan Way surface street. Daily traffic volumes are relatively balanced between northbound and southbound traffic. Traffic volumes are highest in the downtown area and Aurora Avenue/SR 99 area, and they peak during the morning and afternoon commute periods. On a typical weekday, 25 percent of the total daily trips occur in the morning between 6:00 a.m. and 9:00 a.m., while 28 percent occur between 3:00 p.m. and 6:00 p.m.

The number of lanes in different segments of SR 99 is shown in Exhibit 3-8.

9 **Where are the people using the AWW Corridor coming from and going to?**

The corridor primarily serves short regional trips and trips within the city of Seattle. Examples of regional trips served by SR 99 include trips from northwest Seattle neighborhoods to the Sea-Tac International

**SR 99 Corridor - Number of Lanes**



Exhibit 3-8

**What is the AWW Corridor?**

The AWW Corridor includes SR 99, E. Marginal Way, and Alaskan Way from S. Spokane Street up to Ward Street, north of the Battery Street Tunnel.

**What is the PM Peak hour and why is traffic data analyzed for the PM Peak?**

The PM Peak hour is the time period when traffic is heaviest during the late afternoon commute. For SR 99, the PM Peak hour occurs from 4:00 to 5:00 p.m. For this project, PM Peak data was evaluated because overall traffic conditions in and around the project area are the most congested during that time of day.

**Why are the viaduct and seawall important to freight?**

A working viaduct and seawall are critical to international and interstate freight and commerce through the Puget Sound region.

Failure of the viaduct and seawall would push 110,000 vehicles per day (enough to fill two freeway lanes in each direction) onto already overwhelmed parallel freeways and arterials. This could increase congestion by nearly 40 percent. The congestion could severely affect the ability to move freight and goods across the country and to Canada. The seawall also supports the main rail line in the region, which serves both north-south and east-west freight and passenger service.

Airport or trips from downtown to the cities of Shoreline or Burien. It provides access to West Seattle, South Park, downtown, Belltown, South Lake Union, Queen Anne, Magnolia, Ballard, and Fremont.

SR 99 parallels I-5, the most heavily used highway in the Pacific Northwest. I-5 is congested for many hours a day through downtown Seattle, and SR 99 is an important alternative route to, from, and through downtown. It is a major freight corridor providing access for businesses in the SODO and Duwamish industrial areas to northwest Seattle neighborhoods. The corridor is an important route for freight in the Ballard/Interbay manufacturing and industrial area. WSDOT classifies this section of SR 99 as a freight corridor carrying more than 10 million tons per year - the highest classification made. Also, SR 99 is an important link to Safeco Field, Seahawks Stadium, and Seattle Center.

Where are access points provided to and from SR 99?

Between S. Spokane Street and the Battery Street Tunnel, all access to SR 99 is provided via ramps. North of the Battery Street Tunnel, access is mostly provided by surface street connections. Exhibit 3-9 shows SR 99 access and ramp locations and the number of vehicles using these connections daily. Exhibit 3-10 describes the connections.

10 What are typical travel times and traffic flow?

What are typical travel times and flows on SR 99?

For many trips, the afternoon commute is the busiest, so it is used to evaluate travel conditions. In most cases, conditions are better at other times of day. The Final EIS will also describe conditions during the morning commute. Typical travel times for key trips using the viaduct during the peak afternoon travel hour (4:00 to 5:00 p.m.) are shown in Exhibit 3-11.

SR 99 Corridor - Existing Ramps and Daily Traffic Volumes

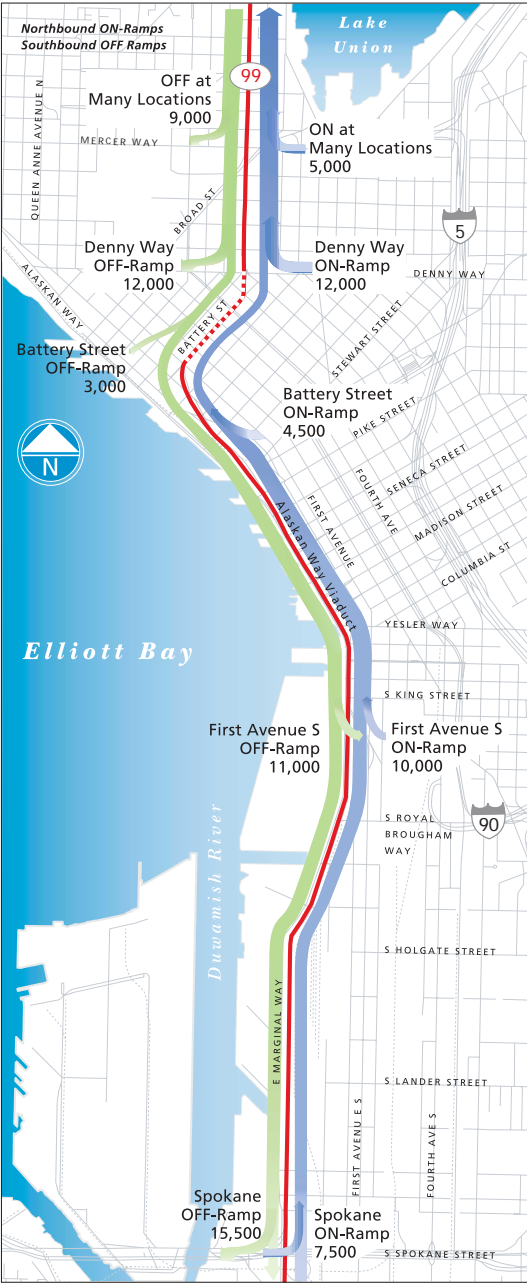
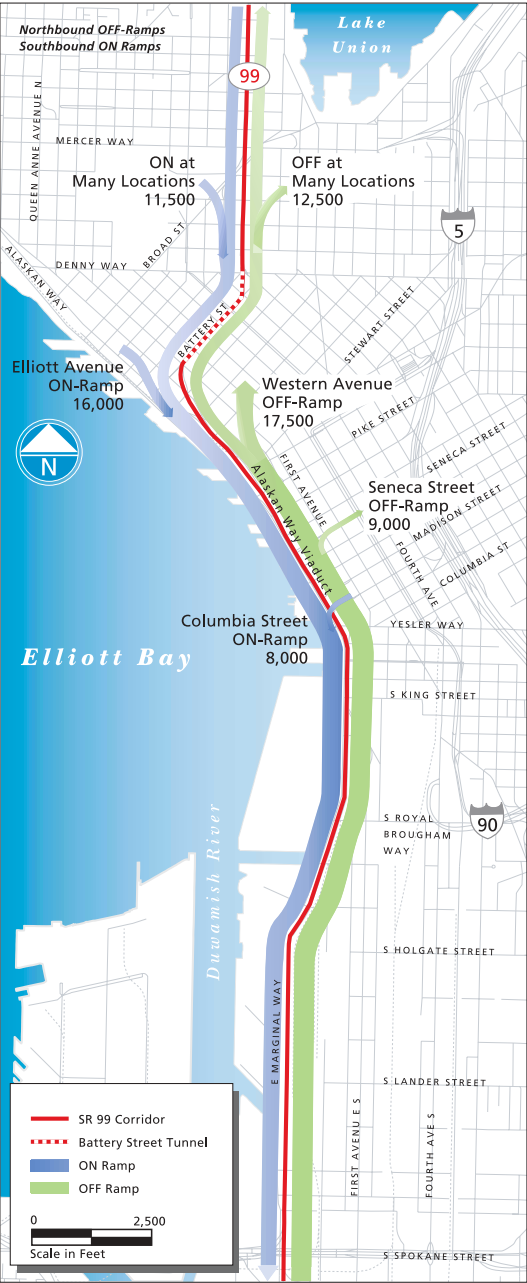


Exhibit 3-10

Summary of Connections Provided To/From the Viaduct

Connections	Access Description
To/From West Seattle	SR 99 connections to/from West Seattle are provided by east to north and south to west off-ramps connecting SR 99 and the West Seattle Bridge.
To/From Stadium Area	A northbound on-ramp and a southbound off-ramp provide access at First Avenue S. near Railroad Way S.
To/ From Downtown Seattle	A northbound off-ramp is located at Seneca Street and a southbound on-ramp is located at Columbia Street.
To/From Elliott and Western Corridor	Full connections are provided by a northbound off-ramp at Western Avenue and a northbound on-ramp near Battery Street. A southbound on-ramp is located at Elliott Avenue with a southbound off-ramp at Battery Street.
To/From South Lake Union Area	Access is provided by a northbound on-ramp and southbound off-ramps at Denny Way and Mercer Street and through several side-street connections.

Exhibit 3-11

2002 Existing Travel Times During the PM Peak (4:00 to 5:00 p.m.)

	Southbound (minutes)	Northbound (minutes)
Aurora Bridge - Spokane Street	8	9
Ballard Bridge - SR 519 (Stadium Area)	12	16
Aurora Bridge - Downtown	15	12
Downtown - Spokane Street	8	10

Exhibit 3-9



Exhibit 3-12

Average Traffic Speeds on SR 99 During the PM Peak Hour  
(4:00 to 5:00 p.m.)

SR 99 Connection	Speed Limit	Southbound	Northbound
S. Spokane St. to near the 1st Ave. S. Ramps	50	44	46
Trucks	40		
Near 1st Avenue S. Ramps to Seneca/ Columbia Ramps	50	41	39
Trucks	40		
Seneca/Columbia to Elliott/Western	40	42	35
Battery Street Tunnel	40*	34	33
North of Battery Street Tunnel	40	39	33

\* Advisory for 35 miles per hour

In general, traffic flows well during the typical afternoon commute, with less than an hour of congestion. Average speeds during the PM Peak are typically within 10 miles per hour of the posted speed limit, as shown in Exhibit 3-12. At times, northbound SR 99 traffic is slowed by traffic that backs up near the off-ramps to Seneca Street and Western Avenue.

How well do local streets and intersections operate?

During the PM Peak hour, there are 10 congested intersections in the project area. Congested intersections are defined as those having 80 seconds or more of delay; highly congested intersections have 110 seconds or more of delay. Using this definition, there are no highly congested intersections today.

How does traffic flow on the Alaskan Way surface street?

The Alaskan Way surface street provides access to waterfront businesses and activities and the Colman Dock Ferry Terminal. For many businesses, such as those on the piers, there is no other access. Approximately 9,000 vehicles per day currently travel on the Alaskan Way surface street. In general, traffic flows along Alaskan Way with minimal delays, except at times when ferry traffic is introduced at the intersections of Yesler Way and Marion Street.

11 What are the existing conditions for specific users?

What are the existing conditions for freight and rail?

The corridor connects areas that generate substantial freight and truck traffic. These include the Ballard/Interbay and Duwamish manufacturing and industrial areas. In addition, light industrial and warehouse areas further north and south of the project area and in the South Lake Union neighborhood also generate truck traffic.

The Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) includes 1,000 businesses employing 14,201 people in the year 2000. Many of these businesses are located there because of the area's marine and railroad access. The BINMIC area is not directly served by SR 99 or I-5, though SR 99 provides primary access since it is the closest and most reliable route through Seattle. Drivers from the BINMIC area reach SR 99 via 15th Avenue W., which turns into Elliott Avenue and connects to the viaduct. Drivers from the Ballard area can also reach SR 99 via Leary Way and N. 39th Street. Alternative routes also lead to Mercer Street and I-5. However, Mercer and I-5 is a less direct and typically more congested route than SR 99.

The Duwamish Manufacturing and Industrial Center (MIC) is another significant generator of freight traffic. It includes Boeing's Plant 2 and most of the Port of Seattle. Within Seattle limits, there are over 1,700 businesses located in this area. Employment in this area is increasing; in 2000, 67,919 people worked in the Duwamish MIC, up from 57,349 five years earlier.

The Port of Seattle owns several container terminals in the Duwamish MIC and is one of the largest West Coast cargo centers, serving as the entry and exit point for marine cargo to and from the Pacific Rim and Alaska. Most of the freight shipped through the port is in containers that are transferred to or from railcars or trucks on the dock. Some of the containers are shuttled by truck to or from the rail yards within the Duwamish MIC. These trucks use several possible routes in the project area, which include SR 519, S.



SR 99 and rail yards in the south section of the project area.

Spokane Street, the Spokane Street Viaduct to I-5 or I-90, E. Marginal Way, the Alaskan Way surface street, and S. Hanford Street. Truck travel to and from Port facilities is fairly constant throughout the workday. Terminal 46, leased to Hanjin, borders E. Marginal Way in the south segment of the project corridor, and is the largest container terminal in the corridor.

Two railroad yards near SR 99 are integral links in moving freight. The BNSF Seattle International Gateway (SIG) Rail Yard is east of SR 99 south of Atlantic Street. The Whatcom Rail Yard is west of E.

Duwamish and BINMIC Industrial Areas



Exhibit 3-13

Why are the viaduct and seawall important to the Port of Seattle?

A working viaduct and seawall provide direct access to the Port of Seattle.

One in three jobs in greater Seattle depends on international trade and over \$23 billion worth of goods travel through the Port of Seattle each year. The viaduct is the first connection from Seattle's port to the state and federal highway system that moves goods and freight to national destinations. Failure of the viaduct or seawall would cripple the freight movement, with effects felt throughout the United States.

Marginal Way and has tracks owned by Union Pacific and BNSF. Both yards have tail tracks that extend well north of the main yard area. The tail track is needed to assemble and sort railcars for both the Whatcom and BNSF SIG Rail Yards.

SR 99 is designated as a high use freight route by WSDOT, and the City of Seattle has designated it as a Major Truck Street. On a daily basis, approximately 2,200 trucks travel southbound on SR 99 and 3,000 travel northbound. Approximately 50 percent of southbound trucks enter SR 99 via the Elliott Avenue on-ramp, and 50 percent of northbound trucks exit at the corresponding Western Avenue off-ramp.

SR 99 provides access for businesses in the Duwamish and SODO (south of downtown) areas and is the primary route for freight to and from the BINMIC. Freight trips in the North Duwamish area, including port-related trips, must share the street system with other uses, including stadium event and ferry access traffic, both of which can overwhelm the street network at times. Rail lines intersect at many passing locations, and rail traffic pre-empts use of the roadway when trains are passing.

The Alaskan Way surface street and Western and Elliott Avenues are designated City routes for oversized or overweight trucks not allowed on the viaduct. Vertical clearance is limited at the Marion Street pedestrian bridge and under the Waterfront Streetcar wire at Broad Street.

**How does transit use the corridor?**

Buses use the SR 99 corridor for routes serving Burien and West Seattle via the Seneca and Columbia Street ramps. Buses serving northwest Seattle using Aurora Avenue and 15th Avenue W. enter and exit SR 99 using the Denny Way ramps. Exhibit 3-14 shows travel patterns and the bus routes using the corridor.

In addition to buses, vanpools from several areas use SR 99. A Waterfront Streetcar runs from Pioneer Square along Alaskan Way to Broad Street. The streetcars run every 20 to 30 minutes, 7 days a week from about 6:30 a.m. to 7:00 p.m., with later hours

during summer months. The streetcar serves many downtown activities and entertainment centers such as the International District, Pioneer Square, the waterfront, Pike Place Market, and Myrtle Edwards Park. It stops at the transit tunnel at S. Jackson Street and the Colman Dock Ferry Terminal.

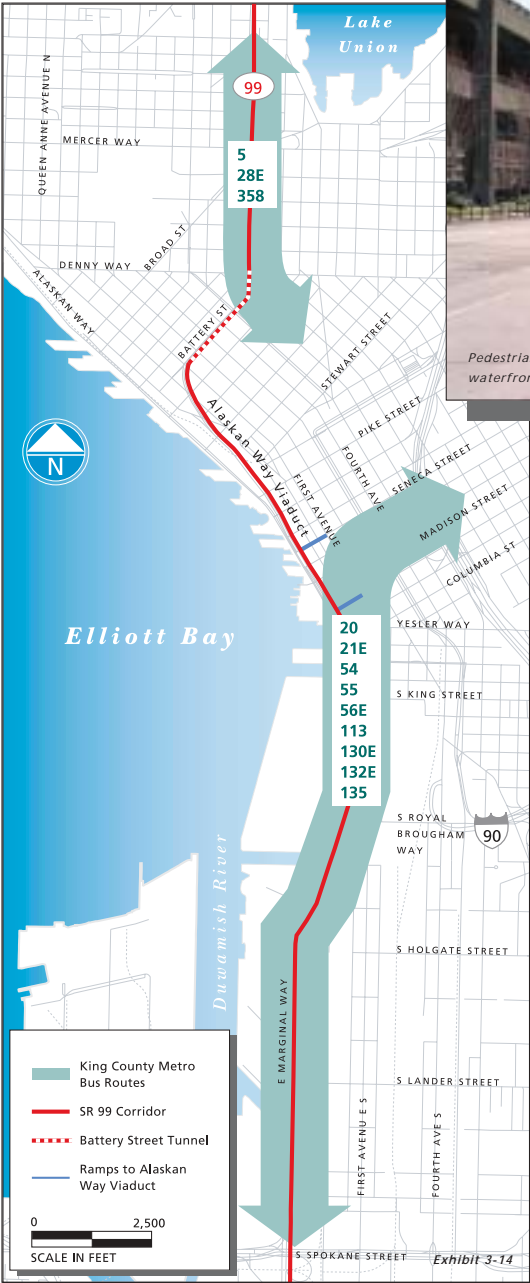
Other transit services in the downtown area include a large network of local and regional buses operated by Metro, Sound Transit, and Community Transit. Daily service from the north, south, east, and west are provided to and from multiple locations throughout downtown.

Sounder Commuter Rail Service is provided at King Street Station near Pioneer Square. Sounder currently operates three commuter trains in the morning and late afternoon between Seattle and Tacoma. It also operates one train in the morning and afternoon between Seattle and Everett. There are also some weekend trips for special events such as Mariners or Seahawks games. Eventually Sounder service to Tacoma and Everett will be expanded to have more trips in both the morning and afternoon. Service will also be extended further south from Tacoma to Lakewood.

Other transit systems that will operate in the future include Monorail and Sound Transit Link light rail. The Monorail Green Line will run from West Seattle to Ballard through downtown, with several stops in neighborhoods along the way. Neighborhoods served will include West Seattle, SODO and the stadiums, Pioneer Square, downtown, Belltown, Seattle Center/Queen Anne, Interbay, Magnolia, and Ballard. Construction is scheduled to begin in 2005, with service beginning in late 2007. Construction of the entire line is scheduled to be completed in 2009.

Link light rail is envisioned to provide the spine of north-south passenger light rail service, with up to 29 miles of rail service. Once completed, light rail will extend from the Sea-Tac International Airport in the south through downtown Seattle, the University District, and eventually up to the Northgate Park-and-Ride. Link light rail will provide a high-capacity transit alternative to move thousands of people through one

**SR 99 Corridor - Existing Bus Routes**





of the most congested corridors in the region. Construction of the first phase, a 14-mile segment beginning near Sea-Tac Airport, running through Tukwila, the Rainier Valley, and into downtown Seattle, is underway and expected to be operating in 2009. Over 42,000 people are expected to use the first segment of the light rail system each day. By 2030, the entire line to Northgate is expected to carry between 90,000 and 125,000 people per day.

**What about the ferries?**

Washington State Ferries operates the largest ferry fleet in the United States. Twenty-five ferries cross Puget Sound and its inland waterways, carrying over 26 million passengers to 20 different ports of call.<sup>8</sup> In downtown Seattle, the ferries operate from Colman Dock Ferry Terminal, located on the waterfront near Yesler Way. Over 9.4 million people each year, or an average of 25,700 arriving and departing passengers per day<sup>9</sup>, pass through the Colman Dock Ferry Terminal by car, vanpool, bicycle, or on foot.

From Colman Dock, Washington State Ferries provides daily ferry service to Bainbridge Island and Bremerton. Two ferries serve the Bainbridge Island and Bremerton routes. There is also a passenger-only ferry that runs Monday through Friday during the morning and afternoon hours from Colman Dock to Vashon Island. Due to a strong population growth in Kitsap County, ridership on the ferries is expected to increase.

Approximately 2.8 million vehicles per year (or an average of 7,700 cars per day) enter and exit the Colman Dock ferry terminal. Vehicle access to Colman Dock is provided from Yesler Way and Alaskan Way, and exits are provided to Alaskan Way and Marion Street. Colman Dock Ferry Terminal currently has holding capacity to accommodate approximately 650 vehicles. When vehicle capacity on the dock is exceeded, vehicles wait on the Alaskan Way surface street in the northbound left turn lane and under the viaduct. This causes congestion for the remaining single lane of northbound through traffic on the Alaskan Way surface street. The number of vehicles that can enter and exit Colman Dock in an

hour is limited by the number of vehicles the ferries and Colman Dock can hold and by the number of drivers that can be processed through the ticket booths. Currently, the intersections at Marion Street and Yesler Way on Alaskan Way are congested during the p.m. peak hour, which means that drivers sometimes wait at these intersections for one minute. The intersection is most congested when a ferry or ferries are unloading, but it recovers quickly.

Over 4.4 million passengers a year, or an average of 12,100 people a day walk to or from Colman Dock. People get to Colman Dock via Alaskan Way or from a pedestrian overpass that connects First Avenue to Colman Dock at Marion Street. During the afternoon peak travel hour, over 6,000 pedestrians arrive at or depart from Colman Dock at Marion Street. In addition, many people get to the ferry on bicycle from various locations in downtown and elsewhere.

**What are the existing conditions for bicyclists?**

The corridor (but not the viaduct) is an important local and regional connection for bicycle travel. Cyclists use the dedicated lanes and trails in the corridor for commuting to work, to access the ferry system at Colman Dock, for recreation, and to get to the many activities along the waterfront and adjacent neighborhoods. Cyclists facing Seattle's hills and busy downtown streets find the flat route along the waterfront an attractive way to get from one place to another. Bike routes in the corridor also link to a regional trail system that connects with local communities to the south and north. The regional trail system connects from Seattle's waterfront through the Cascade Mountains to Eastern Washington.

Beginning in the south, cyclists from White Center and West Seattle can connect via the Duwamish and Alki Trails to the bike route along E. Marginal Way. On E. Marginal Way from S. Spokane Street to approximately S. Royal Brougham Way, bikes share the roadway with vehicles, traveling in a separated striped lane. From S. Royal Brougham Way north to Bell Street, bikes and pedestrians travel along the Alaskan Way surface street on the Waterfront Trail, a multi-use pathway totally separated from the roadway.

The separated trail ends at Bell Street. Cyclists can either share the road with other vehicles along the waterfront up to Broad Street and Myrtle Edwards Park, or they can use the twenty-foot wide sidewalk up to Clay Street. From there, the Elliott Bay pedestrian and bicycle trail continues on to the Interbay and Magnolia neighborhoods. Other major bicycle routes near or in the project area include Second Avenue and Dexter Avenue, which both feature bicycle lanes. Finally, in the stadium area, S. Dearborn Street connects to the I-90 Trail, which provides connections to I-90 and the Mountains to Sound Greenway Trail.

Currently, planned bicycle improvements in the project area include linking the downtown Waterfront Trail to the Mountains to Sound Greenway and the Lake Union to Elliott Bay Trail. The Mountains to Sound Greenway link will use the sidewalk on the north side of S. Atlantic Street between Fourth Avenue and the Alaskan Way surface street. The Potlatch Trail is a planned City of Seattle project that would provide access between the north waterfront area and South Lake Union via Broad Street and other streets near Seattle Center.

**What are the existing conditions for pedestrians?**

The Seattle waterfront is a popular destination for people on foot and one of Seattle's most lively and scenic places to walk. Destinations for pedestrians in the corridor include waterfront attractions; Pioneer Square; Pike Place Market; numerous shops, restaurants and cafes; office buildings; and residences. The Colman Dock Ferry Terminal is especially important for pedestrians. On an average workday, several thousand people walk between their ferries and downtown workplaces. This is one of the biggest concentrations of pedestrian commuters in the region. Most of them cross between levels of the viaduct on a footbridge at Marion Street.

People can walk on the west side of E. Marginal Way/Alaskan Way surface street from approximately S. Spokane Street north to Myrtle Edwards Park. The Waterfront Trail runs on the east side of the Alaskan Way surface street from approximately S. Royal Brougham Way to approximately Bell Street, where

**What are High Accident Locations and Pedestrian Accident Locations?**

“High Accident Locations” are defined as locations less than a mile long that have experienced a higher than average rate of accidents during the previous 2 years.

“Pedestrian Accident Locations” are defined as a section of highway with four or more pedestrian/ vehicle collisions over a 6-year period

<sup>8</sup> Washington State Ferries 2003

<sup>9</sup> Russ East and Tim King, Personal Communication, Washington State Ferries 2004

the separated trail turns into a sidewalk. Pedestrians can use both sides of the roadway, and crossing signals are located at intersections to help people make their way between the east and west sides of Alaskan Way. People on foot can also reach the waterfront via the Marion Street Bridge, which connects over Alaskan Way to Colman Dock; the Bell Street footbridge, which connects over Alaskan Way to the Bell Street International Conference Center; and the Lenora Street footbridge, which connects Elliott Avenue to the east side of Alaskan Way.

North of the Battery Street Tunnel, there are several north-south pedestrian routes; however, east-west routes are limited. The only pedestrian crossings in the area are along Broad and Mercer Streets. Denny Way is the primary pedestrian corridor in this area.

12 Are there any roadway deficiencies for vehicles and pedestrians?

There are several roadway deficiencies on the viaduct that confront drivers on a daily basis. These deficiencies occur on the main elevated structure, the on- and off-ramps, and in the Battery Street Tunnel.

Viaduct roadway deficiencies include:

- Narrow lane widths - In some places lanes are less than 10 feet wide. Highways built to today's standards usually have lanes that are 12 feet wide.
- Narrow shoulder widths or no shoulders.
- Insufficient merge lane lengths and/or auxiliary lanes - The length of the merge lanes to and from the ramp connections are too short, which makes it difficult for drivers using the ramps to safely enter and exit SR 99.
- Inadequate guardrails - The railing on the viaduct is not as strong as barriers used for modern construction.
- Inadequate sight distance - In some locations, drivers cannot see far enough ahead of their vehicles to react to roadway conditions.

Accident locations

From January 1999 to December 2002, there were 753 vehicle accidents, including five fatalities. The majority of the accidents were either with fixed

objects or rear-end collisions. Fixed object accidents were most common on the SR 99 mainline, most likely due to barriers close to moving traffic. Most of the accidents on ramps were rear-end collisions. Traffic backups due to signals near SR 99 off-ramps and design deficiencies such as ramps with inadequate acceleration/deceleration lengths can contribute to rear-end accidents.

SR 99 in the project area has five High Accident Locations:

- Northbound SR 99 south of the First Avenue on-ramp.
- Northbound SR 99 between Western Avenue and Battery Street Tunnel.
- Northbound off-ramp to Western Avenue.
- Northbound on-ramp at Battery Street.
- Southbound SR 99 between the Battery Street Tunnel and Battery Street off-ramp.

The project area has one Pedestrian Accident Location located on southbound SR 99 between Harrison Street and Denny Way.

In addition to the safety issues described above, the Battery Street Tunnel has several roadway elements that would not meet code requirements if the structure were built today. The Battery Street Tunnel does not have adequate:

- Emergency exit locations for evacuating the tunnel.
- Air circulation systems for air quality.
- Fire detection and suppression systems in case of a fire inside the tunnel.
- Electrical, lighting, and communications systems.

13 How many parking spaces are provided in the AWV Corridor?

There are about 2,000 parking spaces in the corridor that accommodate both vehicles and motorcycles. These include parking spaces located from S. Holgate Street to Broad Street on E. Marginal Way/Alaskan Way and areas immediately adjacent to the viaduct. There are three main types of parking spaces found in the corridor, which include:

- 814 Short-Term Parking Spaces - These spaces are metered or have time restrictions.
- 276 Long-Term Parking Spaces - These are free public parking spaces with a 72-hour time limit.
- 900 Other Parking Spaces - These are privately operated pay parking spaces directly adjacent to SR 99 and tenant-only spaces.

In general, the majority of the short-term spaces are located under the viaduct and on the Alaskan Way surface street from S. King Street up to Broad Street. Most of the free long-term parking is located under the viaduct from S. Holgate Street up to S. King Street. The other spaces are spread throughout the corridor.

14 What visual features are located in the project area?

One of the main concerns with the Alaskan Way Viaduct and Seawall Replacement Project is how new structures and facilities might change the overall look of the different areas near the corridor, and how changes to that look might affect people's experience in the area. To understand these issues, it is important to look around and take note of what is currently there. Attractive scenic views, historic buildings, trees, and the waterfront are all positive elements of the visual experience of the corridor. But there are also things that present lower visual qualities like parking lots, some parts of industrial areas, buildings that need maintenance, and to many, the viaduct itself.

The south section of the corridor is located within the Duwamish industrial area, where the most noticeable parts of the view are the large industrial buildings, railroad tracks, and wide roadways. Most of the buildings are two or three stories tall, and even single-story warehouses are 30 to 40 feet tall. The view is cluttered with electric power and telephone lines and signs for businesses. The south end of the existing viaduct is located near Safeco Field and Seahawks Stadium, which dominate the view in much of this area. Closer to the waterfront, the view is of cranes and shipping containers at the Port of Seattle's facilities. SR 99 is mostly elevated in this area, though a short part of the section runs on the surface. The double-level viaduct

A more extensive inventory of visual and aesthetic aspects of the project can be found in Appendices D and E, Visual Quality Technical Memorandum and Visual Simulations.



View of north waterfront



View of downtown Seattle from Pier 56



structure is an obvious part of the view, and its scale is compatible with the many large-scale buildings also found along the working waterfront.

The central section of the corridor passes through some of Seattle's best-known neighborhoods, including Pioneer Square, part of downtown, the central waterfront, Pike Place Market, and Belltown. Much of this section offers views of Puget Sound and Elliott Bay, the Olympic Mountains, and the distant outlines of Bainbridge Island and the Kitsap Peninsula. Each of the neighborhoods in the central section has its own unique look and feel, making this the most visually diverse part of the corridor. One important element all parts of the central section have in common is lively streets that bustle with pedestrians and traffic and offer a variety of sidewalk-level attractions for people in the area throughout the day and into the evening.

At the south end of the central section, the Pioneer Square Historic District's turn-of-the-century buildings and tree-lined streets are reminders that this neighborhood was where old Seattle first grew out of its boomtown beginnings. Characteristic of nineteenth-century architecture, the front doors of many buildings are right up to the sidewalk. Telephone and electric lines in this neighborhood generally run underground, reducing visual clutter. The viaduct runs along the west side of the Pioneer Square Historic District, partially obstructing views to the west.

The downtown commercial core area is located from S. King Street to Pike Street and Western Avenue to Fourth Avenue. This part of the corridor includes many of Seattle's high-rise office buildings, as well as several notable historic buildings from the early decades of the twentieth century. The steep hills of downtown slope toward the waterfront, giving good westward views from streets and sidewalks, open spaces, and buildings. Cars, buses, and trucks crowd the streets and largely contribute to the look in the commercial core. The City of Seattle has included east-west streets in this area in its Green Streets program, which encourages broad sidewalks, landscaping, and other features that make the area more

enjoyable. The City has also designated some east-west streets as view corridors, in which views are to be protected. As in the central section, the viaduct runs along the west side of the commercial core.

The downtown waterfront area follows along the Alaskan Way surface street from Yesler Way to Denny Way. Waterfront views, diverse tourist-oriented attractions, and the maritime ambience make this one of Seattle's most popular areas. In this area, pier buildings that once held goods unloaded from cargo ships and trains now house shops, restaurants, and businesses. A narrow pedestrian promenade and mixed-use trail run the length of this part of the corridor, and the Waterfront Streetcar makes frequent trips along a north-south track leading from Myrtle Edwards Park to the International District. The viaduct runs along the east border of the central waterfront and is the dominant element of views toward downtown Seattle.

Walkways allow pedestrians to go out onto piers for a close-up view of waterfront activities and a view back at the downtown skyline rising over the top of the viaduct. Looking back toward the city from Elliott Bay or from the ends of waterfront piers, the view east is dominated by the high-rise office buildings of downtown. To the south, one can see the cranes and container cargo ships at the Port of Seattle facilities. To the north is the Space Needle and grain elevators. Because of the very large scale of all of these structures, the buildings along the Alaskan Way surface street seem like a minor part of the view. The viaduct blends in, appearing as a grayish band crossing the bottom of the view.

Although Pike Place Market has sweeping outward views, the colorful views from within the market are what make it unique. The market's traditional produce and goods stalls are mixed with a broad variety of shops, restaurants, offices, and apartments. Narrow brick-paved streets, the modest market buildings, and the bustle of street-oriented activities make this a pedestrian-friendly environment. Victor Steinbrueck Park is a prominent green space in this area. The viaduct is adjacent to the park, its top deck located

just below the viewing area on the park's west side. Although the viaduct does not obstruct scenic views in this area, it is a prominent part of the view both to the west and southwest.

The Belltown area is bounded by Pike Place Market on the south, Fifth Avenue on the east, Denny Way on the north, and the east side of the waterfront on the west. One of the fastest growing areas in Seattle, Belltown has many small restaurants and shops, offices, and a growing number of residential buildings, many of them high-rises. East-west streets offer good westward views of the water, of Bainbridge Island and the Kitsap Peninsula, and of the Olympic Mountains. As in other parts of the corridor, scenic views are highly valued, and the City of Seattle has passed ordinances that discourage new development from blocking them. The viaduct runs along the west side of part of this area before turning northeast to enter the Battery Street Tunnel. Views to the west are perhaps partly obstructed by the north-south parts of the viaduct, as are north-south views where the elevated structure crosses Elliott Avenue.

The north waterfront section of the corridor includes the area along the west side of the Alaskan Way surface street from Pike Street up to Myrtle Edwards Park. Like the central waterfront, the look of this area is influenced by its location on Elliott Bay and by piers, boats, a marina, and other waterfront activities. Pier buildings that were once part of the working waterfront have been removed or remodeled for use as shops, restaurants, offices, and a venue for outdoor concerts. New construction includes condominiums, restaurants, a hotel, and an office building built by the Port of Seattle. South of Broad Street, a promenade follows the waterfront, and the Waterfront Streetcar route runs the entire length of this section. Both the Alaskan Way surface street and the BNSF railroad tracks substantially contribute to the look of this section. This part of the waterfront does not seem as lively as the waterfront in the central section, largely because the piers in this area are separated by large spaces without development and associated activities. Additionally, bluffs separate the waterfront from the sites and activities of neighborhoods to the east



*Viaduct near Pioneer Square*

between Pike and Wall Streets. In recent years, efforts have been made to connect the waterfront to areas above with elevators and a pedestrian overpass.

The north section of the corridor includes the part of Aurora Avenue/SR 99 north of the Battery Street Tunnel. Views here are dominated by traffic, the roadway, on- and off-ramps, and ends of east-west streets. The downtown skyline, Capitol Hill, and the greenbelt on the east slope of Queen Anne Hill are visible from the corridor in this area. There are a few motels along and near Aurora Avenue, as well as businesses housed in buildings that are between one and five stories tall, with a variety of types and styles. The different parts of this section do not seem to merge visually as a neighborhood, partially because Aurora Avenue acts as a north-south barrier throughout the section.

15 What are some of the positive and negative visual conditions created by the viaduct?

The Alaskan Way Viaduct is a dominant visual feature along most of the corridor. Motorists traveling north on the top level of the viaduct have broad westward views across the waterfront to the Olympic Mountains and east views of the downtown skyline, sports stadiums, and the Space Needle. Traveling southbound on the lower level, the view is limited by the northbound lanes above, support columns, and buildings along the east side of the viaduct. But motorists there still have a good view to the southwest, especially at the north end of the corridor, where views from the viaduct are very highly valued by many motorists.

From the ground, the viaduct affects the overall look of the corridor in several ways. It partially blocks some westward views from the east side of the corridor and looms above both pedestrians and motorists passing beneath it. In some places along the waterfront, the viaduct all but blocks views back toward the downtown area. Because on- and off-ramps obstruct views from the street level all the way to the top of the viaduct, they are especially noticeable to people in adjacent neighborhoods. The viaduct's size, bulk, and industrial concrete design are discordant with the pedestrian-oriented environment along the central

part of the waterfront, the historic character of the Pioneer Square Historic District, and the shops and offices on the west side of Belltown. The areas below and next to the viaduct are often in the shade, and much of the land beneath the viaduct has been given over to off-street parking and alley-like side streets-places that people pass through to get somewhere else. Because of these various impacts, many people see the viaduct as a barrier-cutting off the central part of the waterfront from the city's core and neighborhoods to the east.

16 How noisy is it in the project area?

Noise from traffic, construction, and the diverse activities of city dwellers is a normal part of life in the corridor. Environmental noise is composed of many frequencies, each occurring simultaneously at its own sound pressure level. The equivalent sound level (Leq) is an averaged sound level reported in A weighted decibels (dBA) to account for how the human ear responds to sound frequencies. To the human ear, a 5-dBA change in noise is readily noticeable. A 10-dBA decrease would sound like the noise level has been cut in half. Typical noise levels are presented in Exhibit 3-15.

Existing outdoor noise levels in the corridor range from 71 to 83 dBA (both for short durations and over a 24-hour period), which is typical for major downtown metropolitan areas. Noise levels tend to be about 10 dBA quieter during the nighttime and early morning hours (midnight to 6 a.m.). Measured noise levels and a map of the measurement locations are presented in Exhibits 4-2 through 4-7 of Appendix F.

High noise levels can interfere with conversation, disturb sleep, and detract from the overall quality of life. Traffic noise levels that approach or exceed the FHWA noise abatement criterion, which is 67 dBA for noise-sensitive outdoor uses such as parks, hotels, and residences, can cause a negative impact from a busy highway. Noise measured at the Washington Street Boat Landing, the Seattle Aquarium, and along much of the waterfront exceeds the traffic noise abatement criteria. With this much noise, it is hard to hold conversations.

WSDOT has also determined that traffic noise above 75 dBA generates a severe impact at outdoor areas frequented by people. In the corridor, there are four sites severely affected by existing traffic-only noise levels. These four sites include a residential building at Ward Street and Aurora Avenue, the Seattle Inn on Aurora Avenue, the Hill Climb Court, and Victor Steinbrueck Park near Pike Place Market. These sites represent 248 residential units, 159 hotel rooms, and one park.

17 Are the neighboring buildings affected by vibration from traffic traveling on the viaduct?

We do not normally feel vibrations from rubber-tired vehicles on the roadways around us. The human body responds to an average vibration decibel level (VdB), which is typically calculated over a 1-second period. The abbreviation "VdB" is used in this document for the average vibration decibel level to reduce the potential for confusion with sound decibels. The threshold for most people to feel vibration is around 65 VdB.

Exhibit 3-15  
Typical Sound Levels

Transportation Sources Other Sources		Description	
Jet Takeoff (200 feet) Car horn (3 feet)		120 dBA	Maximum vocal effort
	Pile Driver (50 feet)	110 dBA	
	Shout (1/2 foot)	100 dBA	Very annoying
Heavy truck (50 feet)	Jackhammer (50 feet) Home shop tools (3 feet)	90 dBA	Loss of hearing with prolonged exposure
	Backhoe (50 feet)		
Train on a structure (50 feet) City Bus (50 feet)	Vacuum cleaner (3 feet) Bulldozer (50 feet)	80 dBA	Annoying
	Blender (3 feet)		
Train (50 feet) City bus at stop (50 feet) Freeway traffic (50 feet)	Lawn mower (50 feet) Large office	70 dBA	Intrusive
	Washing machine (3 feet)		
Light Traffic (50 feet)	Television (10 feet) Talking (10 feet)	60 dBA	
Light traffic (100 feet)		50 dBA	Quiet
	Refrigerator (3 feet)		
	Library	40 dBA	
	Soft whisper (15 feet)	30 dBA	Very quiet

Source: FTA 1995, EPA 1971, EPA 1974

Additional information on noise is contained in Appendix F, Noise and Vibration Discipline Report.

What is dBA and VdB?

dBA stands for an A weighted decibel. A weighted decibels measure sounds at frequencies that people can hear.

VdB designates vibration decibels. It is a measure of the average vibration level.

Noise

Noise impacts occur when traffic noise approaches or exceeds 67 dBA at sensitive locations, such as parks. Severe noise impacts occur above 75 dBA. Severe noise impacts also occur when interior noise levels increase by 15 or more decibels compared to the existing levels or are over 60 dBA.



Today, a person standing next to one of the vertical piers supporting the Alaskan Way Viaduct would sense that the ground was rumbling beneath them. This is because vibration levels measured on the ground 3 to 5 feet from the vertical piers ranges from 66 to 89 VdB. These vibration levels are represent the sum of vibrations from a range of different weight trucks, and irregular roadway conditions. In addition, the mass and span of the viaduct concentrates vibrations from heavy vehicles to the piers of the viaduct. The levels are below the Federal Transit Administration (FTA) recommended damage risk criteria for extremely fragile buildings of 95 VdB. These vibrations can be felt, but do not generally damage buildings. Ground vibration levels decrease substantially over distance. At distances of 25 feet or more from the vertical piers, the vibration levels would be below 65 VdB. Most perceptible indoor vibration is caused by sources within buildings, such as operation of mechanical equipment, movement of people, or slamming of doors.

18 What is the character and land use in the project area?

The corridor passes through seven of the City of Seattle's neighborhood planning areas. At the south end of the corridor, the route begins in the Greater Duwamish neighborhood, with its large-scale industrial buildings, Port of Seattle cargo container facilities, Seahawks Stadium, and Safeco Field. In the Pioneer Square neighborhood, the many nineteenth-century buildings make it Seattle's most historic neighborhood and one of its most distinctive. The commercial core includes shops and stores of all sizes and most of the skyscrapers that make up Seattle's skyline. It also includes the thriving central waterfront. The Belltown neighborhood, the Denny Triangle, and Uptown (Queen Anne) are highly diverse, with retail, offices, open space, and increasing numbers of multi-family residences. The Uptown neighborhood also includes the Seattle Center, one of the city's most popular open spaces. At the north end of the corridor, the South Lake Union neighborhood includes a mixture of business, retail, and residential uses and is bordered by the south shore of Lake Union.

19 What parks and recreational facilities are located in the project area?

The corridor is home to some of the most popular public facilities in the city. Public open spaces include Occidental Park, Pioneer Square, Waterfront Park, Victor Steinbrueck Park, Myrtle Edwards Parks, and the Seattle Center. Private or semi-public open spaces include several of the waterfront piers and the plazas and terraces around the Seattle Art Museum and Benaroya Hall. Cultural, environmental, and educational facilities include the Seattle Aquarium and the interpretive center at the Klondike Gold Rush National Historic Park. Viewpoints include Jack Perry Memorial Viewpoint, Waterfront Park, and Victor Steinbrueck Park. Trails include the Waterfront Trail, which connects to several adjacent trail systems like the Mountains to Sound Greenway Trail and the Elliott Bay Trail in Myrtle Edwards Park. Outdoor art is located throughout the corridor, including sculptures, fountains, and murals. Although many of these attractions are located at a distance from either the viaduct or proposed replacement structures, some of them might be affected by the project.

Parks, public art, and recreational facilities in the corridor have been identified and mapped. The recreational facilities category includes several types of land uses, such as viewpoints, open spaces around buildings (both public and private), shoreline access points, and the trails, promenades, and walkways that allow people to make their way through the corridor without relying on cars. Also included are Green Streets-streets designated by the City of Seattle, on which the City encourages sidewalk widening, landscaping, and other pedestrian-oriented features.

20 Who lives in the project area, and what population characteristics shape the neighborhood?

The project area encompasses a number of neighborhoods in downtown Seattle, each distinct with its own character and diversity of residents. The Duwamish industrial neighborhood located at the south end of the project area has few residents, but thousands of workers commute to jobs in the area on a daily basis. The historic and diverse Pioneer Square neighbor-

hood is located further north and is home to the Seahawks Stadium and Safeco Field. Belltown, north of the downtown core, is characterized by a mix of mid- and high-rise offices, neighborhood shops, and residences. The neighborhood has undergone substantial redevelopment over the past decade, and many expensive condominiums and apartment buildings have been built overlooking the waterfront. This mixed neighborhood also has many old hotels and apartment buildings, some of which have been converted into subsidized housing. In addition, the corridor passes through small sections of the Lower Queen Anne neighborhood and the Denny Triangle area. The Seattle Center, site of the 1962 World's Fair, is a regional civic center hosting theatre, ballet, opera, exhibitions, festivals, and professional basketball. The older light industrial South Lake Union area is just east of the north end of the project.

The residents of the project area include many kinds of people. Like the rest of the city, approximately a quarter of the residents are minorities and Latinos. The proportion of minorities (non-white) is a bit lower in the project area compared to the city, but a higher percentage of Latino persons live in the project area. Nearly three-quarters of all residents live alone, and only a small number of families with children live in the area.

People who live in the project area include some of the city's richest and some of its poorest. They reside in new luxury downtown condominiums and apartment buildings, older apartments and converted old hotels, subsidized housing, and homeless shelters. Some people live on the city streets and even sleep under the viaduct itself.

Compared to the rest of Seattle's population, the project area has a much higher proportion of people (twice as high) who live at or below the poverty level and a higher percentage of people with disabilities and mobility limitations. Almost half of the residents across this spectrum of income do not own a private automobile (three times the city rate) and rely on walking or public transit for transportation. Low-income residents, minorities, the elderly, and those



Elliott Bay from Victor Steinbrueck Park

Appendix H contains more specific information related to parks and recreation.
<div>What is Environmental Justice?</div> <div>Good outreach means that all people potentially affected by the viaduct project have the opportunity to participate by receiving information, attending meetings, or providing input into public decisions. Environmental Justice is a federal requirement that says in addition to good outreach, projects should provide equitable benefits to minorities or low-income populations and that any adverse effects are not disproportionate to these traditionally underserved groups.</div>
More information on the people and communities along the corridor can be found in the Social Resources Technical Memorandum (Appendix I) and Environmental Justice Technical Memorandum (Appendix J).

with disabilities are protected by a combination of laws, policies, and an executive order called Environmental Justice (E.O. 12898, issued 1994).

Exhibit 3-16  
Project Area Population Characteristics in 2000  
(2000 Census)

	Project Area	Seattle
Population	15,839	563,374
Percent Minority <sup>1</sup>	26	30
Percent Latino <sup>2</sup>	8	5
Percent At or Below Poverty Level	25	12
Percent Disabled with Mobility Limitations	9	6
Percent Transit-Reliant	49	16

<sup>1</sup> Minority includes persons of all races except White.

<sup>2</sup> Latino persons may be White or a Minority race.

21 What community and social services serve these neighborhoods?

Many people who live in the project area have very low income, disabilities, or other problems affecting their daily lives. Help and support is offered by a variety of community-based organizations and government agencies located in the project area neighborhoods.

These organizations provide hot meals and sack lunches, hygiene facilities, donated clothing, and emergency housing (shelters). Many also offer counseling to help people manage personal problems such as substance abuse, domestic violence, or mental health. Others provide employment training, referrals for day labor, job placement, and structured daytime activities.

Within five blocks of the corridor there are 38 residential buildings containing an estimated 2,605 subsidized housing units (apartments or rooms). The area has six residential buildings providing transitional housing services and 10 emergency shelters for homeless persons and families.

Most of the government agencies and organizations providing these services depend heavily upon volunteers from church groups or the community and operate on very limited budgets. Without this help, more people in the project area might be found living on the streets or be unable to survive in the area at all.

22 What utilities and public services are located in the project area?

The project area serves as a major utility corridor critical to providing services in Seattle. Seattle City Light, Seattle Public Utilities, and numerous private companies have utility pipelines or cables located in the project area. Utility infrastructure located in the project area includes electric power, communications (telephone lines, fiber-optic lines, and cable television lines), water, sanitary and storm sewers, steam, and the Seattle Department of Transportation's traffic signal system. Electrical power conduits are also attached to the existing viaduct, and two major transmission lines are buried under the viaduct. Natural gas, refined petroleum products (like gasoline), and other fuels have conveyance lines through the downtown project area. Although largely hidden beneath the pavement, these utilities are rarely considered, but we depend on their continuous availability. If these utilities were interrupted or failed, Seattle's daily life would be significantly disrupted.

Public services and facilities located in the corridor include emergency medical services, police, medical clinics, public schools, postal services, disaster preparedness, solid waste pick-up, and recycling. Harborview Medical Center, a major regional trauma center, is located just to the east of the corridor on Ninth Avenue. Several fire stations are located within or adjacent to the corridor, including Fire Stations No. 2, 5, and 10. Fire Station No. 5 is located on the waterfront, near the Colman Dock Ferry Terminal, and is the base for both engines and fireboats. Although no police stations are located within the corridor, the West Precinct of the Seattle Police Department is located nearby at Eighth Avenue and Virginia Street. The Colman Dock Ferry Terminal is the operations center for the Washington State Ferry System. Farther south along the Alaskan Way surface street, the Coast Guard has a facility where both rescue vessels and ocean-going Coast Guard vessels are docked.

23 What are the existing conditions for the local and regional economy?

Together, Seattle and King County are a national center for manufacturing, high technology industries, services, international trade, and tourism.<sup>10</sup> King County has the largest concentration of manufacturing businesses in the Pacific Northwest and is home to the fifth largest warehouse and distribution center in the United States.<sup>11</sup>

International commerce plays a large role in the local economy. The Port of Seattle is one of the largest West Coast cargo centers, serving as a gateway for cargo shipped to and from Alaska and countries along the Pacific Rim. In 2002, two-way foreign trade through the Port of Seattle amounted to over \$23 billion.

There are over 81,000 companies in King County. Nearly 1.1 million civilian workers were employed in King County in 2003, while about 67,000 individuals (6.6 percent) remained unemployed.<sup>12</sup> In the year 2000, 540,419 people were employed within the city of Seattle, 34 percent of them in the downtown Seattle Central Business District.<sup>13</sup>

Within a one-block area of the corridor, there are about 1,100 businesses.<sup>14</sup> Over half (52.3 percent) of these businesses are commercial office spaces. The remaining portion includes other service-oriented businesses (17.1 percent), commercial retail (11.7 percent), other general uses (10.0 percent), residential multi-family (5.0 percent), industrial (1.7 percent), and government services (1.7 percent). The vast majority of businesses (78.5 percent) were observed to have fewer than 20 employees on site. Medium-sized businesses, defined as 20 to 100 employees, accounted for 16.6 percent. The remainder was almost equally split between large businesses (greater than 100 employees) at 2.6 percent and vacant businesses at 2.3 percent. Businesses within the corridor depend on parking spaces, freight delivery spaces, and transit to accommodate employee and customer travels as well as freight transport.

A full description of the utilities and public services provided in the corridor is provided in the Public Services and Utilities Technical Memorandum located in Appendix O.

**Why are the viaduct and seawall important to business in downtown Seattle?**

A working viaduct and seawall are critical to business operations in downtown Seattle.

Downtown Seattle is a hub of regional, national, and international business and finance. The seawall holds much of downtown Seattle's land mass in place. The loss of the seawall would put a large area of downtown at risk of landslides into Elliott Bay, causing huge potential loss of life and property as well as overall business operations. It could also have major impacts to Seattle's utilities, causing disruptions for commerce in Washington and the rest of the country.

Appendix P contains additional information about economics.

<sup>10</sup>EDC 2003

<sup>11</sup>EDC 2003

<sup>12</sup>PSRC 2002, 2003b

<sup>13</sup>PSRC 2002

<sup>14</sup>Parsons Brinckerhoff 2004

24 Is air quality a concern?

Air quality in the project area must be examined due to the dense urban environment of Seattle and the high volume of traffic. Advances in motor vehicle emission control technology have caused pollutants to drop over the last 20 years, even though the number of vehicles has increased. Air quality standards protect human health and welfare from the following pollutants associated with motor vehicles: ozone, nitrogen dioxide, particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), and carbon monoxide. Carbon monoxide is the pollutant most associated with the localized effects of motor vehicle emissions. It is a colorless, odorless, poisonous gas that reduces the blood's oxygen-carrying capability.

Procedures established by the Puget Sound Regional Council (PSRC) and the United States Environmental Protection Agency (EPA) were used to estimate localized carbon monoxide concentrations. Particulate matter (PM<sub>10</sub>), oxides of nitrogen, and hydrocarbon emissions were evaluated at a regional scale to compare the effects of the alternatives on other pollutants.

Over 90 percent of carbon monoxide emissions in Puget Sound urban areas come from transportation sources. Using a very conservative modeling approach, existing worst-case carbon monoxide concentration models exceeded the 8-hour average standard for carbon monoxide at four intersections in the corridor (Second Avenue and Madison Street, Second Avenue and Spring Street, Alaskan Way and Marion Street, and Elliott Avenue and Western Avenue). The estimated exceedances under existing conditions reflect conservative modeling assumptions, including peak-period traffic conditions, worst-case meteorological conditions, high background carbon monoxide concentrations, and atmospheric stability that may not persist in the study area; therefore, the exceedances may never actually occur. Further details are provided in Section 5.5.1 of Appendix Q.

Regional trends show the recent decrease in carbon monoxide concentrations continuing into the future. The future trend for ozone shows a leveling off of concentrations through 2020 and increasing emissions of hydrocarbons (which largely affect ozone for-

mation in the central Puget Sound) by 2030. There have been no recorded exceedances in the project area for particulate matter (PM<sub>10</sub>) in the last 10 years. These trends are demonstrated in Exhibits 5-1 and 5-2 of Appendix Q.

25 What fish and wildlife species (including those threatened and endangered) are in the project area and what is their habitat like?

Fish, wildlife, and vegetation resources within the corridor are primarily located along the shoreline and Elliott Bay between S. King Street and Myrtle Edwards Park. Shoreline habitat along the Seattle waterfront and the Duwamish estuary has been highly modified by urban development. The water habitat in the project area is separated from Seattle's upland shoreline by a vertical concrete wall within the intertidal zone (area that is exposed during low tides) with rock riprap at lower intertidal and shallow subtidal elevations (areas normally covered by water). Nearly half the shoreline length has piers extending from the shoreline over the intertidal and shallow subtidal area. No natural shoreline remains along the waterfront from the Duwamish River mouth up the western side of Elliott Bay.



Fish habitat in the project area is limited. However, some species exist at the intertidal shoreline. The fish species listed

as threatened under the Endangered Species Act (ESA) for the area are Puget Sound Chinook salmon and bull trout. The Seattle waterfront is a migration corridor and rearing area for juvenile Chinook and other juvenile anadromous salmonids. Chinook salmon that spawn in the Duwamish River could pass through the project area. Some bull trout also occur in the Duwamish River, but spawning populations have not been found.

Juvenile salmon are commonly present at various protected locations near the water's surface in the vicinity of the seawall during spring migration. Juvenile salmon feed on tiny aquatic animals called zooplankton.

The area adjacent to the seawall and between Pier 48 to Colman Dock could have areas of essential fish habitat for West Coast groundfish. There are 83 species of groundfish, although not all have been identified in the area. As a whole, groundfish use a wide variety of habitat.

Fish species commonly observed in the shoreline area along the seawall include seaperch, bay pipefish, shiner perch, sculpins, greenling, various flatfishes, and a few lingcod. The habitat along the seawall is also occupied by a range of marine invertebrates such as red crab, hairy crab, coon-striped shrimp, octopus, starfish, and anemones.

Marine vegetation commonly found along the Seattle waterfront includes green algae (sea hair, sea lettuce, sea cellophane), red algae (crisscross network, red ribbon, bull-kelp laver, turkish towel, splendid iridescent seaweed), and brown algae (sugar kelp, wireweed, seersucker, rockweed, ribbon kelp). The bottom of larger open areas along the seawall is essentially covered with these algae species, where sufficient gravel and cobble material is present in water depths of up to 30 feet.

On land, there is no natural vegetation in the project area. The highly urban waterfront includes a few trees and shrubs planted along the Alaskan Way surface street and other nearby streets. The small amount of wildlife present in the area has adapted to human activity and a modified environment.

Birds that are commonly found in this urban environment, including robins, sparrows, and crows, generally feed on the ground and along the streets. Raptors such as osprey, peregrine falcon, and bald eagles have been observed along the corridor but do not nest in the corridor, other than one peregrine falcon nest on top of an adjacent building. The bald eagle is listed as threatened under ESA. Bald eagles sometimes forage along the Seattle waterfront as well as other shorelines within the city, where they prey upon fish, waterfowl, and seabirds. The Seattle shoreline is not known as a wintering area for bald eagles. Waterfowl species that can be found along the Seattle waterfront include

More information is available in the Air Quality Discipline Report located in Appendix Q.
Additional detail on the habitat and the fish and wildlife species in the project area can be found in the Fisheries, Wildlife, and Habitat Discipline Report in Appendix R.
<b>What are anadromous fish?</b>  Anadromous species swim upstream from the sea to spawn (reproduce) in fresh water.
<b>What is a CSO?</b>  Combined sewer s carry sewage from homes and businesses in the same pipe with stormwater. CSOs occur when the rainfall volumes exceed the pipe capacity. When a combined sewer overflows, water is discharged directly to Puget Sound without being treated at a treatment plant.
The Department of Ecology recognizes that the Duwamish River is heavily used by fish, wildlife, and people (WAC 222-16-031, RCW 90.58).
<b>What is the 303(d) list?</b>  The Environmental Protection Agency (EPA) requires Ecology to prepare the 303(d) list to periodically assess the quality of water in the state by collecting data. Based on this data, Ecology prepares a list of all waters in which beneficial uses, such as salmon habitat and recreational uses, have been impaired due to poor water quality. Ecology then uses this list to develop plans to improve water quality. The 303(d) list is a requirement of the federal Clean Water Act (33 U.S.C. § 1313(d)).



several types of gulls, loons, grebe, cormorant, and blue heron.

26 What are the existing water quality conditions in the Duwamish River, Elliott Bay, and Lake Union?

Buildings and impervious surfaces, such as concrete and asphalt, cover nearly 100 percent of the project area. Urban activities in Seattle, including the construction and use of buildings and roadways, has degraded the water quality of the waterbodies surrounding the project area for more than 100 years. The waterbodies in the project area are the Duwamish River, Elliott Bay, Lake Union, and Puget Sound. Sources of pollutants that affect these waterbodies include discharges from industrial facilities, combined sewer overflows (CSOs), spills, contaminated groundwater, and urban storm runoff.<sup>15</sup>

The project area covers a total of approximately 98 acres, and surface runoff discharges at 19 major outfalls in the project area. Approximately 43 acres in the project area drain to the Duwamish River and Elliott Bay, which comprise a watershed of 372,500 acres. The project area makes up less than 0.01 percent of the overall watershed. Runoff in the remaining 55 acres of the project area drains to the regional combined sewer system, which includes about 1,990 acres in Seattle.

Duwamish River

The Duwamish River originates where the Green and Black Rivers merge, and it flows approximately 13 miles to Elliott Bay. The Duwamish River is the primary freshwater source to Elliott Bay. The mouth of the Duwamish River is divided by Harbor Island into two channels, the East and West Waterways. The Duwamish River's East Waterway is located adjacent to the southern portion of the project area and carries between 20 and 30 percent of the river's flow, depending on the tidal conditions.

Washington State Department of Ecology (Ecology) has designated the following uses for protection in the Duwamish River: salmon and trout rearing, supply for industrial water, agricultural water, livestock

watering, wildlife habitat, fishing, commerce and navigation, boating, and aesthetics (WAC 173-201A).

Elliott Bay

Elliott Bay is an estuary that makes up the eastern portion of central Puget Sound (Ecology 1994). In the project area's shoreline, Elliott Bay is relatively shallow.

Ecology has designated Elliott Bay as excellent, which means the goals for the waterbody are to have excellent quality and to support aquatic life such as salmon migration, rearing, and spawning and shellfish habitat. Ecology has also designated the following uses for protection: primary contact recreation, wildlife habitat, fishing, boating, aesthetic enjoyment, commerce, and navigation. The area of Elliott Bay near the Denny Way CSO outfall has been listed on the 1998 Ecology 303(d) List of Impaired and Threatened Waterbodies for exceeding fecal coliform criteria.

Lake Union

Lake Union is located north of the project area. Only a small portion of the project area drains to the Lake Union Watershed. The water quality of Lake Union is influenced by freshwater flows coming from Lake Washington and from storm drains and CSOs.

Ecology has designated Lake Union as Lake Class water quality and Ecology has designated the same uses as Elliott Bay for protection.

Puget Sound

Puget Sound is a large marine waterbody that covers approximately 900 square miles, including Elliott Bay. Other than the area of Elliott Bay near the Denny Way CSO outfall, Puget Sound has not been listed on Ecology's 303(d) list. Ecology has designated the same uses for protection.

27 What are the nearshore sediment conditions in the Duwamish River, Elliott Bay, and Lake Union?

Urban-area activities have degraded the quality of nearshore sediments in the Duwamish River, Elliott Bay, and Lake Union. Discharges that contain pollutants from combined sewer overflows (CSOs) and



Exhibit 3-17

stormwater outfalls and direct runoff have contaminated sediments with a variety of metals and chemicals.

A list of pollutants can be found in Appendix S, Water Resources, Attachment F.

<sup>15</sup>Ecology 1995a

Duwamish River

The East Waterway of the Duwamish River is adjacent to the project area and is listed on Ecology's 303(d) list for exceedances of sediment standards, not for exceedances of water quality standards.<sup>16</sup>

Within the project area, the Lander combined storm drain and CSO outfall and the Hanford CSO outfall are the major outfalls that discharge to the East Waterway of the Duwamish River. Sediment samples in this area have exceeded the sediment quality standards for several metals and organic compounds. Those chemicals include polycyclic aromatic hydrocarbons (PAHs), phthalates, polychlorinated biphenyls (PCBs), cadmium, copper, arsenic, silver, zinc, and other organic compounds.

Elliott Bay

Sediments in Elliott Bay are listed for exceeding state standards for numerous pollutants. Sediment criteria exceedances are generally associated with previous industrial activities, stormwater discharges, and CSO outfalls. As shown in Exhibit 3-18, Elliott Bay has also exceeded sediment cleanup standards for several pollutants in surface sediments adjacent to outfalls located in the project area.

Exhibit 3-18  
Pollutants Exceeding Sediment Standards at Outfall Locations Along the Central Waterfront<sup>1</sup>

Pollutant	King Outfall <sup>2</sup>	Washington Outfall <sup>3</sup>	Madison Outfall <sup>3</sup>	Senca Outfall <sup>3</sup>	University Outfall <sup>3</sup>	Pine Outfall <sup>3</sup>
Mercury	X	X	X	X	X	X
Silver	X	X		X		
Lead	X	X				
Zinc	X					
LPAH <sup>4</sup>			X			
HPAH <sup>5</sup>			X			X

<sup>1</sup> Sediments are located within 250 feet of the outfall (Appendix S).  
<sup>2</sup> King County facility.  
<sup>3</sup> City of Seattle facility.  
<sup>4</sup> Low molecular-weight polycyclic aromatic hydrocarbons (LPAH) - specifically include Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Methyl-naphthalene.  
<sup>5</sup> High molecular weight polycyclic aromatic hydrocarbons (HPAH) - specifically include Benz(a)anthracene, Benzo(a)pyrene, Benzo(g,h,i)perylene, Dibenzo(a,h)anthracene, Chrysene, Fluoranthene, Indeno(1,2,3-cd)pyrene

Lake Union

Lake Union is on Ecology's 1998 303(d) list for exceeding sediment criteria.

28 How is stormwater from the viaduct and Alaskan Way surface street currently managed?

For thousands of acres in central Seattle, including a portion of the 98-acre project area, stormwater runoff is collected in a complex system of pipes that make up a combined sewer system for drainage and sanitary sewage. The normal operation of the combined sewer system is to convey flows to the West Point Wastewater Treatment Plant for treatment and eventual discharge to Puget Sound. But in heavy wet weather, flows can exceed capacity, leading to the direct discharge of a portion of the combined stormwater and sanitary sewage to nearby water bodies at designated combined sewer overflows (CSOs). This is one of the ways in which contaminants in stormwater runoff from the project area can pollute local water bodies. The total volume of stormwater runoff from the project area currently collected in the combined sewer system is approximately 21 million gallons per year.

In other parts of the project area, separate storm drains directly discharge stormwater (possibly containing runoff contaminants but presumably free of sanitary sewage) with only minimal treatment to local water bodies, including Elliott Bay, the Duwamish River, and Lake Union. The total volume of stormwater runoff from the project area collected in separate storm drains is approximately 47 million gallons per year.

In the remaining project area, stormwater is collected in separate storm drains that divert water from smaller storms, as well as the typically contaminated first flush from larger storms, into the combined sewer while discharging other runoff directly to local water bodies. The total volume of stormwater runoff from the project area collected in this hybrid collection system is approximately 38 million gallons per year.

The configuration of systems is so localized and complicated that in some areas, the runoff from the viaduct itself and the surface street below are not managed in the same way. For example, runoff from the viaduct may discharge directly to a local water body, while runoff from the surface street discharges directly to the treatment plant.

When stormwater runoff from the project area discharges to local water bodies, it does so from 19 major and many smaller outfalls in the area. Most of

Washington State announced sediment management standards for marine waters in 1995. The sediment quality standards include specific concentration limits for a broad spectrum of chemicals. Waterbodies are included on the 303(d) list if the sediment quality standards are exceeded. Sediment cleanup screening levels have also been established as part of the sediment management standards. These concentrations are the minimum cleanup levels to be achieved in all sediment cleanup actions.

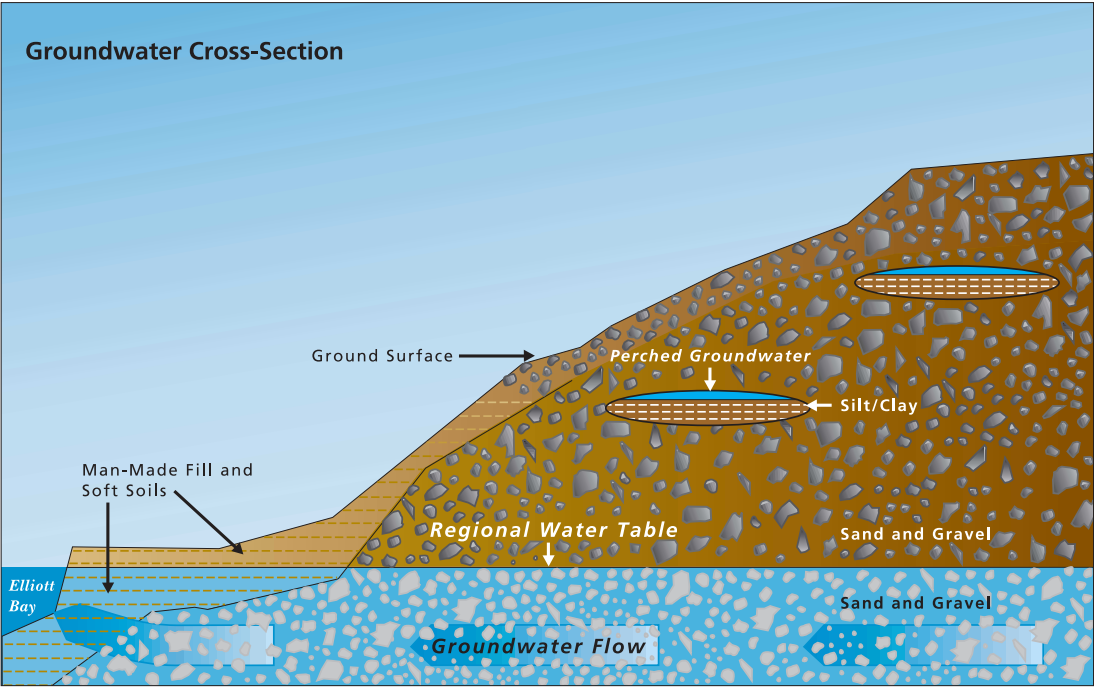


Exhibit 3-19

this discharge from the central section of the viaduct and the north waterfront project area enters Elliott Bay. Runoff from other portions of the project area discharges into the Duwamish River, Puget Sound, or Lake Union. In comparison to the overall watershed affecting these water bodies, the project area is very small-about one hundredth of one percent of the total watershed area. For that reason, the quantity of pollu-

<sup>16</sup>Ecology 1995b

tants from the runoff is very small when compared to the total quantities of pollutants discharged to the local water bodies. However, the overall problem of polluted runoff entering local waters is a very important issue.

To add to the complexity of the stormwater runoff and wastewater issues, drainage and sewerage ownership and operation responsibilities are split between King County and the City of Seattle. Both jurisdictions have long-term plans for improving water quality, including improved control of CSOs. More information on Seattle's planning for the combined sewer system is available in the Combined Sewer Overflow Control Plan (1988 and amended in 2001). The central waterfront has not been a priority basin for the City's CSO reduction strategy, but was examined in the document Drainage Wastewater Systems/ Alaskan Way Viaduct Alternatives<sup>17</sup>. King County has a Combined Sewer Overflow Control Program that is updated every 5 years. The last program update was in 2000. Additional information on the County's infrastructure investment planning is available in the Regional Wastewater Services Plan<sup>18</sup>.

The project area interfaces with some major sewer projects identified in these planning documents. In particular, the Regional Wastewater Services Plan, for instance, identifies a proposed storage and treatment facility for CSOs at Royal Brougham (Connecticut) for construction in 2026. The analysis of the project stormwater impacts and pollutant loading has been prepared for the year 2030. It assumes that the Royal Brougham CSO facility will be in operation by that time.

29 What are the groundwater conditions in the project area?

Groundwater conditions are affected by the geology and soils that groundwater flows through, by Puget Sound, and to a lesser extent by Lake Union on the north edge of the project. Groundwater moves more easily through sand and gravels, while soils that contain silt and clay slow down the movement. The line below which all of the space between soil particles is filled with groundwater is the water table.

In general, the regional water table is flat throughout the project area. The depth to the water table is variable depending on the elevation of the ground surface. Along the waterfront, the depth to the water table ranges from about 6 to 12 feet. Near the Battery Street Tunnel, the regional water table is generally between 100 and 135 feet below ground surface. North of the Battery Street Tunnel, the regional water table is shallower because the ground surface dips downward toward Lake Union. In some areas, small zones of shallower groundwater perch on top of silt or clay soils, as shown in Exhibit 3-19.

The range in the depth of the water table along the waterfront is partially due to the effects of the tides in Elliott Bay. The amount of up and down movement of the water table depends on the distance from Elliott Bay, the types of soils, and the type of seawall. In the south section of the project area, the change in the water table is small from the tides because of the types of soil and the distance from Elliott Bay. In the central and north waterfront sections of the project area, the seawall often acts as a barrier between the water table and Elliott Bay. Water table changes from the tides along this section are generally less than 3 feet, except in the vicinity of Yesler Way, where the seawall is a Pile-Supported Gravity Wall. In this area, the water table changes from 6 to 10 feet and is almost directly related to the tide level in Elliott Bay.

30 Are there any potentially contaminated sites in the project area?

Contamination is expected to be widespread in the sediments along the entire Seattle waterfront. Past industrial and commercial activities, railroad operations, and hazardous materials in the fill may have contaminated soil and/or groundwater within the corridor. Out of a total of 641 upland sites and one in-water site consisting of sediments along the Seattle waterfront, 209 sites have the potential to be substantially contaminated and 433 sites are considered to be reasonably predictable for contamination (Exhibit C-1, Attachment C).

Substantially contaminated sites pose a potential risk for costs and complications, both in real estate acqui-

sition and construction. Substantially contaminated sites are typically large and/or have large volumes of contaminated material and/or have a long history of industrial or commercial use. Examples of operations that could create substantially contaminated sites include wood treating, metal plating, large bulk petroleum facilities, refineries, and hazardous material treatment facilities.<sup>19</sup>

Reasonably predictable sites are typically small to medium in size (generally less than 2 acres), contain potential contaminants that are not extremely toxic or difficult to treat, and can be cleaned up using straightforward cleanup approaches. Examples of the types of operations that can create reasonably predictable sites are gas stations, auto repair shops, small manufacturing operations, buildings with asbestos and/or materials containing lead paint, and other operations that use aboveground or underground storage tanks.

There are six general types of contamination in the project area:

- Oil (mid- to heavy-range petroleum hydrocarbons)
- Gasoline
- Metals (such as arsenic, chromium, lead, and mercury)
- Solvents (such as trichloroethylene [TCE] and tetrachloroethylene [PCE])
- Polychlorinated biphenyls (PCBs)
- Fill (potentially contaminated) and treated timbers

In the south section (S. Spokane Street to S. King Street), industrial activities have included metal works, foundries, machine shops, boat building and repair, warehouses, and fueling facilities, including several bulk fueling facilities. For example, the Standard Oil Company of California operated a large tank farm from the early 1900s until the 1980s on Terminal 30, between S. Holgate and S. Lander Streets. In the early 1900s, fill material was placed in the south section covering timbers and piles that had been used for piers, wharves, and railroad trestles. Some of the buried timber was treated with creosote to preserve the wood. The preserved wood could be classified as a dangerous waste. The most common contaminants from industrial activities are solvents,



View of the Viaduct at S. Royal Brougham, just below Pioneer Square.

Appendix U, Hazardous Materials, contains detailed information for known contaminated sites and sites of concern.

<sup>17</sup>Brown and Caldwell 2002

<sup>18</sup>King County 2004

<sup>19</sup>WSDOT 2003



petroleum, and heavy metals. These contaminants may be present in the soil and fill.

Existing sources of contaminated material include the current rail yards. Some alternatives may relocate the existing rail facilities in the south end. Because of their history and use, rail yards often have soil and groundwater contamination associated with solvents, petroleum products, lubricating oils, and heavy metals use.

In the central section (S. King Street to the Battery Street Tunnel), First Avenue was historically known as Front Street and was the location of the original shoreline. The area between the end of the piers and First Avenue was a series of planked-over trestles and railroad tracks, which was gradually filled in with soil, wood waste, ship ballast, and other refuse in the early 1900s. Many of the piles supporting the trestles were treated with creosote, which could have leached into the surrounding soil. Forty-one former dry cleaners, 55 former gas stations/repair shops, and 20 former metal works operations were identified in this section. Historically, there were also many print shops in the area. Contaminants from these types of businesses include solvents, lubricating oils, and gasoline, which can readily migrate in the subsurface soil and groundwater.

Since the early 1900s, the Seattle Steam Company has operated a steam plant in the central section at Western Avenue and University Street. The steam plant used a heavy oil, called Bunker C, to fuel its steam plant, and the oil is now found in the soil and groundwater. The oil plume has migrated northwest and has been found in samples taken near the viaduct's footings. The extent of the contamination is not known. The Bunker C oil is the most likely source of the hydrogen sulfide ( $H_2S$ ) that has been encountered directly south of the steam plant.

In the north waterfront project area (Pike Street to Myrtle Edwards Park along the waterfront), the soils and groundwater are likely contaminated with low levels of petroleum. Seven former gas stations/repair shops and six former metal works operations are locations of concern. The former Union Oil tank farm site between Broad and Bay Streets, just north of the Old

Spaghetti Factory restaurant, has several documented sources of contamination. Although the site has been cleaned up considerably, some diesel remains in the soils and shallow groundwater on-site.

The north project area (Battery Street Tunnel to Ward Street) was shaped by the leveling of Denny Hill in 1929. Commercial and light industrial businesses developed rapidly after the regrading. In the 1930s through the 1950s, there were approximately 80 gas stations/repair shops and several automobile dealerships in this area, most of which have since been converted to other uses. Fourteen dry cleaners and eight metal work operations were also identified in the historic records for this area. Many of these businesses are no longer in operation, and property uses have changed. Consequently, there is a high potential to encounter petroleum in soil and groundwater. Locally, dry cleaning solvents may also be encountered.